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ORGANIC EVOLUTION

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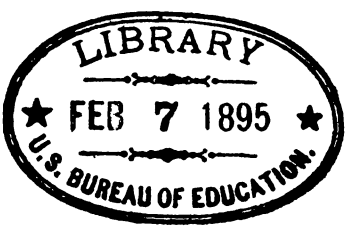

A Syllabus

OF A COURSE OF ELEMENTARY LECTURES DELIVERED
IN LELAND STANFORD JUNIOR UNIVERSITY

— BY —

DAVID STARR JORDAN

A sacred kinship I would not forgo
Binds me to all that breathes.

—BOVESEN.

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EVOLUTION.

LECTURE I.

THE UNROLLING OF THE UNIVERSE. ORGANIC EVOLUTION: THE DEVELOPMENT OF FORMS OF LIFE.

I. Evolution Considered as a Science. — The study of changing beings as affected by unchanging laws.

"Nothing endures save the flow of energy and the rational order that pervades it." — *Huxley.* No one dipping his hand in the river can be twice wet with the same water. Shortness of human life as compared with duration of world processes. Objects seen by a flash of lightning during a storm appear immovable. So the phases of nature seem unchanged to the casual observer. His view so short. Parable of the rose and lily who thought the gardener immortal. "Dauer im Wechsel": persistence in change.

Epochs in science study. "Die neue Weltanschauung."

Seeing the objects in nature. (1) As they appear. (2) As they really are. (3) As they were (4) As they are, their present condition being an inevitable result of what they were, the laws of their being leading on to what they are to be.

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Seasons return because conditions return, but conditions never return in the world of life.

What we know we know not as a permanence, but as a phase of change.

Nothing in the universe due to chance or whim. Meaning of law. "The ascertained sequence of events."—The necessary sequence of events. The fall of a leaf follows fixed law as much as the fall of a planet. This true of everything we can know of. The creation of man or the growth of a state as much natural processes as the formation of an apple or the growth of a sand-bank.

The exact sciences, those in which data are most simple or most accessible. The inexact sciences—the sciences of life are inexact only because the human mind can never seize all their data. The law of rain. It never rains when it can do otherwise. A broken law means the failure of the universe. In this sense laws can never be broken. The laws of nature not the executors of human justice. Each law has its own result and no other. Each one tends in its own way toward cosmic order. "If God should wink at a single act of injustice, the whole universe would shrivel up like a cast-off snake skin."—(Arab proverb.) Each law the expression of the best possible way in which causes and results can be joined. Emerson's remark on being "sound and solvent." The laws of nature, expressions of the soundness and solvency of the Infinite force. A broken law would be the expression of unsoundness and insolvency. The gradual recognition of law constitutes the progress of science. Cost of every step. Analogy to individual growth.

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Science of Evolution depends on all other sciences, and embraces them all, as no science can be separated from the study of the development of that which it treats. Organic Evolution concerned by all phenomena of life. Immense literature of Evolution.

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LECTURE II.

Evolution as a Working Hypothesis.

II. Evolution as a Theory. — The theory of the formation of species by divergence and development; in narrower sense, the theory that all forms of life now existing, or that have existed on the earth, have sprung from a few primitive forms, or, more likely, from one. "That whilst this orb has gone circling on in obedience to the fixed law of gravity, endless forms most beautiful and most wonderful have been or are being evolved."—*Darwin.*

This theory at first "a working hypothesis." All contrary hypotheses have long since ceased to work. The theory of Evolution as the method of creation of species as well attested as the theory of gravitation. All biological investigation must assume it; without it most such investigations impossible. Naturalists could no more go back to the old notion of separate creation for each species and its organs, than astronomers could go back to the pre-scientific notions of guiding angels as agents controlling planetary motions. No naturalist whose studies give him the right to an opinion on the origin of species now holds this view; no one could hold it and look an animal in the face.

III. Evolution as a Method of Study.— Studying the present in the light of the past. The easy work of

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science mostly done. Those who would continue work must study not living objects, but the laws that govern them. "Whether planets, or mountains, or mollusks, or subjunctive modes, or tribal confederacies be the things studied, the scholars who have studied them most fruitfully were those who have studied them as phases of development. Their work has directed the current of thought."—*John Fiske.*

IV. Evolution as a System of Philosophy.—Work of Herbert Spencer, John Fiske, and others. Systems of philosophy based on scientific knowledge can be rewritten as knowledge progresses. Systems resting on aphorisms, or definitions, or assumptions must wholly die as knowledge increases. Philosophy never identical with truth. Partial truth in philosophy becomes absolute falsehood as the growth of exact knowledge transforms the truth to science, leaving the error. Conflict between science and philosophy. Philosophy the evanescent perspective in which the facts and phenomena of the universe are seen. Philosophy changes with the point of view. Science the same to all minds capable of grasping it.

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LECTURE III.

What Evolution Is Not.

I. Not that "man is a developed monkey." No monkeys or apes now existing could have been ancestors of primitive man. As man changes and diverges so do they. None of them conceivably ancestors of future races of man. Evolution is essentially movement toward better adaptation to conditions of life. Movement of monkeys toward simianity, not humanity. But all evidence points toward descent of all mammals, of all vertebrates, from a common stock. The simian races nearest man, and their divergence from a common stock comparatively recent.

II. Not that all living forms are tending toward humanity. Not that "every favorable variety of the turnip is tending to become man." — *Wilberforce.* Not "the growth of the highest alga into a zoophyte, a phenomenon for which sharp eyes have sought and which is not only natural, but inevitable on the Darwinian hypothesis, and whose discovery would make the fame of any observer." — *Seelye.* Humanity not the goal of Evolution. Humanity the goal of human Evolution, perhaps. Goal of Evolution adaptation, mostly by slow divergence.

III. Not series of sudden and radical changes. Not that a flying fish in the air would see his "scales disparting into feathers." Not that a horse should give

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birth to a cow or a cow to a horse. Seasons change, but midsummer never changes to midwinter, or the reverse, except by gradual stages. Life is conservative and changes slowly, but must constantly change.

IV. Not "an innate tendency toward progression." Degeneration in Evolution as well as progress. Divergence and adaptation not necessarily progress. Gradation not necessarily progression.

V. Not spontaneous generation. Ancient belief in spontaneous generation. Modern belief in it. Tyndall's experiments. No evidence that generation ever occurs without parentage. Theoretical argument for it. How else could life begin? We do not know how, or where, or when life began. Theoretical evidence against spontaneous generation. If occurring once would occur again under like conditions. All life seems bound in unity, as if arising from one common stock. Spontaneous generation implies many stocks. If spontaneous generation exists we would have no means of recognizing it. Spontaneous formation of protoplasm—an organism fresh from mint of creation would be too small—too simple for recognition by any human instrumentality. Size of a molecule of protoplasm.

VI. Not identical with the Hindoo theories of reincarnation. Science not advanced by speculative philosophy or by philosophic meditation.

VII. Not a creed or body of doctrine to be believed without being understood.

VIII. Not a new religion, "the religion of the future."

IX. Not to be controverted by authority in the name of philosophy, theology, or religion. "*Roma locuta est:*

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causa finita est," not a dictum recognized by science. Her causes never finished. Science cannot admit that any power on earth possesses the answer to her questions. Human knowledge her only court of appeal. Science is "knowledge set in order."

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LECTURE IV.

Variety in Life.

Variety everywhere. "Nature likes to know her creatures." Commonness the cloak of variety. The green cloak which covers the brown earth the shield under which millions of organisms, brown and green, carry on their life work.

Meaning of Species. — A single kind of living object. "Species are the twigs of a tree, disconnected from its parent stem. We name and arrange them arbitrarily in default of ability to reconstruct the whole tree in accordance with nature's ramifications." — *Coues.*

Linnæus; Systema Naturæ, 1758: Four thousand species of animals.

Zoological record—10,000 each year now added. Each volume thicker than the one before it. Number of species of animals now known, high in the millions; no one knows how far. Still more of plants. Extinct hosts. All these species phases of change. Variety within species; no two individuals alike. No one ever matched two clover leaves. Immense range of individual variation. The variations due to: (1) Innate tendencies, the "unseen powers" within. (2) To stimulus of surroundings, the "unseen powers" of environment. (3) To double parentage, the "unseen powers" of heredity. (4) Unlikeness of germ cells of same individual.

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Advantages of variety in nature enables existence of more life; saves waste; saves destructive competition. "Purposes of nature." Analogy to human devices. Teleology.

Species made up of individuals. They change with space and with time. With space, because with space comes barriers; with time, because it brings events producing divergence. Neither time nor space flow on evenly in the world of life. Variations grow greater with lapse of time and space, for these bring other events and form other barriers.

Is there a law of variation? If variation exists it has its meaning. It is produced by fixed laws; it is governed by fixed laws. What is the origin of species?

While species change, their types persist. Essential unity in variety.

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LECTURE V.

Unity in Life.

Essential unity amid variety. Persistence of plan. Types of structure very few. Embryology shows like plan in organisms seemingly unlike. All organisms are cells or clusters of cells filled with protoplasm; each cell provided with a nucleus and its chromatin, and with the associated structures by which the work of a cell is performed.

Homology.— Its existence; its significance; its distinction from analogy. Homology in structure; homology in development; man and dog; man and alligator. Homology through descent. Homology through common descent. Common descent the sole known source of homology. Homology means blood relationship. Homology is the stamp of heredity. The law of unity has its basis in the influence of heredity.

All laws of life apply to man, to the lower animals, and to "our brother organisms, the plants," each in its degree.

Principal factors in Organic Evolution:

I. Heredity.—"Like begets like"; creatures resemble their ancestors.

II. Irritability.— All living beings respond to external *stimulus*. They are moved by or they react from every phase of their surroundings.

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III. Individuality.— No two organisms are exactly alike.

IV. Self-activity.— Development of structures depends on the exercise of functions.

V. Natural Selection.—The survival of the fittest in the struggle for existence.

VI. Mutual Help.—The race not to the swift nor the battle to the strong, but to those who can keep together.

VII. Isolation.—Effects of individual separation from bodies of organisms.

The interaction on protoplasmic structures of these factors or groups of forces and of others more or less known the cause of Organic Evolution.

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LECTURE VI.

Heredity: The Great Conservative Force in Evolution.

"Like begets like." "Blood will tell." Creatures resemble their ancestors. Each creature in a sense a mosaic of its ancestry, rather than an "ego." "The specialization of the single cell, which is capable of repeating the whole with the precision of a work of art."

With birth "the gate of gifts is closed." These gifts the hereditary stock which one generation receives from that which precedes it.

"Science finds no ego, self, or will that can maintain itself against the past. Heredity rules our lives like the supreme primeval necessity that stood above the Olympian gods. 'It is the last of the fates and the most terrible. It is the only one of the gods whose name we know.' . . . We are possessed, not by demons, but by the dead. These are the real ghosts which throng our lives, haunt our footsteps, remorseless as the furies. We are followed by the shades of our ancestors, who visit us, not with midnight squeak or gibber, but in the broad noonday, speaking with our speech and doing with our deed. On the stage of life the actors recite speeches and follow stage directions written for them long before they were born."—*Edward A. Ross.*

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"Vom Vater hab' ich die Statur,
Des Lebens ernstes Führen;
Vom Mütterchen die Frohnatur
Die Lust zu fabuliren."—*Gœthe.*

"Stature from father and the mood,
Stern views of life compelling;
From mother I take the joyous heart,
The love of story-telling.
Grandfather's passion was the fair.
What if I still reveal it?
Grandmother's pomp and gold and show,
And in my bones I feel it.
— *Bayard Taylor's Translation.*

Laws of heredity seem to be the same for all living creatures. This is a strong evidence of their common origin. Value of pedigree.

Galton's suggestion as to the possibility of charts of heredity, like charts of harbors. Difficulty in their compilation.

Persistence of hereditary qualities. *Atavism.* The colt from Milpitas with three hoofs on two of its feet.

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LECTURE VII.

Theories of Heredity.

The cell regarded as the unit in phenomena of life. Reasons why the cell may not be the life unit. Cells forced to form organs. Organs built up of cells.

The sexual cell specialized to carry all the qualities of the parent, both latent and developed.

I. Theories of Encasement and Evolution.

II. Theory of Epogenesis; building up of structure; one cell upon another.

III. Darwin's theory of Pangenesis. Each cell sending out from itself to every part of the body gemmules or minute buds; "these inconceivably minute and numerous as the stars in heaven." Each of these capable of reproducing the qualities of the cell it came from.

IV. Brooks. Differentiation of sex in gemmules. The male gemmules active and varying, the female sessile and conservative.

V. Weismann's theory of continuity of germ plasm from generation to generation. Germ cells and somatic cells. Nucleus the directive part of the cell; virtually unchanged from generation to generation except by forces within it. External changes of the *soma* do not reach it.

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LECTURE VIII.

The Cell and Heredity.

First animals (protozoa) one-celled. Consisting of a sac filled with protoplasm, the physical basis of life. Qualities of protoplasm. Within the protoplasm, the *nucleus*, composed chiefly of loops and bands of *chromatin*. The chromatin presides over the development and differentiation of the protoplasm, action itself being a function of the protoplasm. Action of the *asters* or attraction spheres. Limitation in size of protozoa. Cell division of protozoa. Rapidity of multiplication. One would fill the bulk of the sun in a month if all the conditions were favorable.

Law of Mutual Aid.—(1) Its beginning shown in aggregation of cells. So-called immortality (Unsterblichkeit) of protozoa not immortality of the fabled demigod Ares, who when hurt "bellowed like ten thousand bulls," but could not die. They die only when the activity of their protoplasm is checked by outside influences. Natural death not known to them. Must be fully alive or fully dead. No intermediate stage. Aggregation of cells leads to increased size, specialization of parts, sensitiveness, intelligence, and natural death. Natural death a necessary resultant of differentiation of structure. Simplicity, ignorance, and immortality in the process of Evolution exchanged for sensibility, pain, and death. How "Brahma fell

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from unity and serenity to multiplicity and pain." Was this "a gigantic mistake, a stupendous blunder of the blind unconscious force from which there is no escape until the world is hurled back into nothingness by the supreme efforts of the human will"?

(2) Its beginning shown in conjugation of cells. Exchange of experiences. Development of conjugation into the complex sex phenomena of the metazoa.

Sexual cells in *metazoa* (many-celled or compound animals). These primarily alike and like protozoa. Become specialized by sex differentiation into: (*a*) *spermatozoa*, mobile cells composed chiefly of nucleus; and (*b*) *ova*, sessile, immovable cells provided with food yolk for the nourishment of the new cell structures. How a cell divides. Lengthwise splitting of *chromatin* under influence of asters or attraction spheres. Equal division; never quite equal.

Boveri's experiments. Transfer of nucleus from egg to egg in echini. As the nucleus is, so is the resultant animal, whether developed in its own egg, or its own protoplasm, or in that of another.

Analogous transfer of nucleus in protozoa. The chromatin determines what the resultant animal shall be.

Many-celled animals really compound. Edmund B. Wilson's experiment with the lancelet. Division of egg; when of two cells into two, each forms one animal, half normal size; division when segmented into four forms four animals, each one-fourth size; division into eight, each cell seems a ciliated infusorian, but dies before further division. Could be true of all animals at all times were it not that mutual aid induces mutual dependence.

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Amphimixis, mingling of *chromatin* units; idants, ids, biophores, gemmules. This mixing supposed to correspond to the mixing of elements of character or of structure in the new individual. Dimorphism of living beings. Primary purpose of amphimixis to increase variation. Lack of variation means destructive competition and wasted opportunities.

Parthenogenesis; its occurrence when an immediate brood is needed, and variation undesirable. A character of degeneration. Its analogy to budding.

The polar bodies. Their origin and significance. Female mother cells form four daughter cells. These unequal; one with food yolk and half normal amount of chromatin. The three others (polar bodies), without food yolk, are cast off and do not develop. Male mother cells divide into four daughter cells, all alike. Studies of *Ascaris*.

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LECTURE IX.

Amphimixis.

Amphimixis consists in fusion of chromatin in two cells prepared for the process. Sex cells fundamentally alike. This is shown in:

1. Their origin.
2. Conjugation of equal protozoa.
3. Homology of spore-producing organs.
4. Low feeding produces males; high feeding, females.
5. Maupas's experiment: Heat produces males; cold, females.
6. Parthenogenesis of male cells; produces weak individuals from lack of food substances.
7. Formation of sex cells in male and in female by division of mother cell into four.

Two phenomena (first noticed by Harvey, 1651):

1. Heredity; mixture of parental character in offspring, through mixture of idants (ahnenplasma) carried in the chromatin.
2. Sex differentiation, in growth of individual after the cell-growth has begun and idants are mixed.

Units of heredity. Their combinations infinite.

Galton's estimate: Twenty-five per cent. from each parent; six and two-thirds per cent. from each grandparent; remainder unidentified variation and atavism.

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The embryo of both sexes fundamentally alike, but the germ cell develops in one of two ways, according to unknown and doubtless varying stimuli. Without a stimulus each nucleus is sexless. (*Watase.*)

Fertilization not a rejuvenation, but a mixing of characters. Each new individual would be a "branch or elongation of the parent" (*Erasmus Darwin*), except for *amphimixis*.

Inherited dependence prevents ordinary cells from acting as germ cells in higher animals. Growth by budding or fusion in lower animals or plants.

Inherited dependence prevents parthenogenesis in any of the higher forms of life.

"Nature has no better way of encouraging variation than by preventing individual germ cells from developing alone."

"Whatever is desirable in Nature becomes necessary as soon as it is possible."—*Weismann.*

The infinitely little shown in units of heredity. The question of size a relative one; on either side extends infinity.

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LECTURE X.

The Meaning of Sex.

"Whatever is desirable becomes necessary as soon as it is possible." Law of natural selection. Division of labor in organs and organisms. Division of labor between sexes. Neither sex superior nor prior to other. Mutual help involves mutual dependence. Specialization involves helplessness. Progress implies certain degradation of non-specialized structures. Law of "Compensation."

Egg-bearing creatures less active than those not so burdened. Activity co-ordinated with strength. Co-ordination of sensorium, brain, and motion.

Progress of Evolution makes embryo more and more important; the waste less and less.

Retention of eggs saves them from early destruction and lessens their number; saving of eggs through fertilization before extrusion; by viviparity; by nourishment by milk; by care for young. Destruction of Saurians, who did not care for the young. Viviparity, and lactation, and care make a birth important. "But one young one at a birth; but that was a lion."

Saving with plants through flowers and insect help. Petals are leaves modified to call insects. One of Nature's advertisements. Winds and pines. Waste of pollen.

Parents differentiated as protectors of young. Give

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to the young more and more of environment, as well as of heredity. Continued life of adult animals, justified in Evolution, by care for the young.

Sex differentiation produces change in life-habits, and this reacts on the organism. Strength, push, and initiative more and more thrown on the male. Devotion and sympathy; radicalism and conservatism.

Mental and physical qualities of men and women as affected by division of labor. Women rarely excel as explorers, investigators, judges, or warriors. Excel in delicacy, devotion, sympathy, and self-sacrifice. Excel as defenders of young. Female animal always most dangerous when at bay. The defender of the young must be a partisan; not a judge.

Growing demand for longer environment on part of parents. Demand for mothers, not merely nurses or chambermaids, but capable of becoming life-long parts of the environment of the strongest and noblest men. "Das Ewigweibliche."

That division of labor best which will justify itself by being. Nature corrects inequalities by submerging those not in harmony with her purposes. Agitation loosens the bond of the past, and leaves freer influences of the future. The movement of Evolution renders justice to all alike. The best to be is what can be.

"For woman is not undeveloped man, but diverse."
Tennyson's "Princess."

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LECTURE XI.

The Cell Theory.

Prof. Oliver P. Jenkins.

The cell theory is a conception of the nature of the organization of plants and animals, which has been the result of the gradual growth of ideas in regard to the structure of organisms since the application of the microscope to this study.

The theory has been from time to time modified in the light of a clearer understanding of the cell — its relationships, its minute structure, and its properties.

Investigations and discussions now in progress in regard to the minute structure of the cell and the interpretation of its parts promise further greatly to modify our conceptions of the organization of living forms.

Still the cell theory in its main outline represents the present conception of the structure of organisms. It forms a most valuable point of view from which to consider the whole world of living forms, both from the standpoint of structure (morphology) and from that of activity and function (physiology).

Statement of the Cell Theory. – That the cell is the unit of organization in both the plant and animal world.

All organisms consist of cells and cell-products.

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The most simple organisms consist of a single cell.

The most complex of countless numbers of cells so united that they are thrown into groups (the tissues), which are arranged into such structural relationships that they form special mechanisms (the organs). The whole has that mutual relationship of parts, both in structure and function, that constitutes a complex yet complete organism.

An organism consisting of a single nucleated cell possesses in a certain degree all the physiological properties — the power of accomplishing the physiological processes, *e. g.*, assimilation, disassimilation, irritability, contractility, reproduction, etc., that any organism possesses.

An organism consisting of great numbers of cells differs from the more simple one-celled form in that in it development has proceeded to the point where groups of cells have become more adept in performing a certain physiological process (*e. g.*, gland cells — secretion; muscle cells — contraction), while other groups accomplish better other processes; thereby there having been accomplished in the organism what has been termed the "physiological division of labor."

Every cell arises from a pre-existing cell by division of the first. The countless multitudes of differently formed cells of the most complex organism can in each case be traced to a single cell, the ovum, all having arisen from this one by growth and repeated divisions.

Hence all the properties of the cells produced by the last division came by descent from the first. All the forms of organs and their arrangement into the

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whole organism is the result of the methods of growth, reproduction, and grouping of the cells.

These views of the cell place its study at the foundation of structural (morphological), of physiological, and of what may be termed the philosophical studies of organisms.

While for the conceptions above set forth the cell may be taken as the unit, it must be kept in mind that the cell itself is of very complex organization. It has parts, each with its special properties and functions. The cell is the unit in the sense that its parts live and act only in the relations in which we find them organized in the cell. While a single cell may live alone, its parts cannot do so. In the growth and development of the organism the advancement is made by the repetition of the whole cell as the unit.

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LECTURE XII.

The Physical Basis of Heredity.

Prof. Frank M. McFarland.

I. Heredity.—The law of persistence in a series of organisms. Like produces like.

II. The Cell.—The physical basis of life.

1. Its structure. (*A*) Protoplasm.—(*a*) Spongioplasm; (*b*) Hyaloplasm. (*B*) Nucleus.—(*a*) Chromatin; (*c*) Achromatin; (*d*) Nuclear membrane.

2. Protoplasm a morphological, not a chemical conception. Its complexity.

3. Its fundamental phenomena. Assimilation and metabolism. Growth, irritability, contractility, reproduction.

4. Cell multiplication. "Omnis cellula emcellula" changed to "Omnis nucleus e nucleo." The spindle, attraction spheres, and centrosomes exist for the purpose of dividing the chromatin, the probable vehicle of heredity between the two daughter cells.

III. Multiplication Among Protozoa.—Macronuclei and micronuclei. Fission and conjugation. Amphimixis.

IV. Multiplication Among Metazoa.—Histological differentiation into body or somatic, and reproductive cells. The origin of sex.

1. The reproductive cells. Ova and spermatozoa.

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Their difference only an apparent one. Fundamentally alike, as seen in their development.

V. Fertilization and Amphimixis.

VI. Recent Theories of Heredity.— Their use as working hypotheses. "Even error, if it originate in correct deductions, must become a step towards truth." Darwin, Spencer, Galton, Brooks, Nägeli, DeVries, Weismann, Wiesner.

VII. Views of Weismann.— Morphoplasm and idioplasm. The structure of the germ plasm. The chromosomes or idants the bearers of heredity tendencies. These made up of:

1. *Biophores*, or Lebensträger, the ultimate vital units. Various, but perfectly definite numbers of them form

2. *Determinants*, vital units of the second order. Each of these is the Anlage of a particular cell or group of cells. These constitute and occupy definite positions in the architecture of the vital units of the third order, the

3. *Ids.* In the process of development of the individual, its ontogeney, these ids break up with a qualitative distribution of each group of determinants to its appropriate place in the adult organism. These ids may correspond to the visible "microsomes."

4. The origin of variations.

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LECTURE XIII.

The Inheritance of Acquired Characters.

An *acquired character* one gained after birth as a result of action or non-action, or of reaction from environment. Distinguished from an *innate character* carried over in process of heredity. An acquired character not a new thing, but one resulting from change in relative development of organs or qualities. Results of winning or losing in life, as the "gate of gifts closed" at birth. Is it closed rather with amphimixis? with process of conception?

Affirmative View.— Neo-Lamarckism.

The parable of the owl and the egg. McFarland's application of it to the present problem. Which is first, the soma or the ovum? Can the life experiences of the soma affect the ovum? Are latent and developed characters alike inherited?

"All that has been acquired, begun, or changed in the structure of individuals in their life time is preserved in reproduction and transmitted to the new individuals which spring from those who have inherited the change."— *Lamarck: Fourth Law of Evolution.*

"Change of function produces change of structure; it is a tenable hypothesis that changes of structure so produced are inherited."— *Herbert Spencer.* (1) The Darwinian principle: Natural selection. (2) The sup-

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posed Lamarckian principle: Inheritance of acquired character.

The Madeira beetles, without wings. (1) Their wings lost through inherited disuse. — *Lamarckian principle.* (2) Their wings lost through natural selection.—*Darwinian principle.*

The webbing of ducks' feet. (1) Grows through inherited results of effort. (2) Grows through natural selection.

Fishes in caves become blind. (1) Through inherited disuse. (2) Through panmixia or cessation of selection.

The monkey's dread of snakes.

The mocking-bird's dread of owls.

Pointer dogs. Snapping turtles. Pawing for water.

Change of feet of animals through strains on ankle-bones.

Has functional activity a directive power, as giving a line of least resistance to activity of next generation?

Inheritance of education; noble effort.

Experience; effects of environment. Is my heredity my grandfather's environment? Is there reality in Ibsen's "Ghosts"? (1) Inheritance of mutilations; experiments of Brown-Sequard. (2) Previous fertilizations; horse and jack. (3) Pre-natal impressions; many cases on record; few of them verified; none conclusive. Watching the reapers day by day, that the child may love the harvests. Striped calves; Weismann's sheep.

Diversion of heredity by forces not understood. Inheritance of acquired characters less than usually supposed. If existing at all, probably chiefly in-

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heritance of reaction tendencies produced by functional activity. Determining line of least resistance. May be wholly imaginary, but almost universally taken for granted. Growth of Neo-Lamarckism.

Civilization the inheritance of the successes of the past.

"Considering the width and depth of the effects which the acceptance of one or the other of these hypotheses must have on our views of life, the question, Which of them is true? demands beyond all other questions whatever, the attention of scientific men."—*Herbert Spencer.*

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LECTURE XIV.

The Inheritance of Acquired Characters.— Continued.

Negative View.— Neo-Darwinism.

Weismann's essays on heredity. Contradicted two ideas long unquestioned: (*a*) Inheritance of characters acquired; (*b*) Fertilization a process of rejuvenation. His work a great stimulus to investigation.

Weismann's distinction between *germ cells* and *soma* or body cells. Is this "a biological myth"? Germ cells from same body never alike, because of inequality of division of nucleus. Germ cells of new body like those of old, except that qualities of two are fused through amphimixis.

Germ cells immortal as the protozoa are. Each new soma a reincarnation of the germ cell. The soma and its experiences cannot affect a germ cell, except to lower its vitality. "Mens sano" must be "in corpore sano."

Ibsen's ghosts. Effect of waist-compression, cigarette, alcoholism. Are these inherited, producing a more and more vicious and less and less vitalized race? Are these not inherited, but showing their effects in lowered vitality? Are these not inherited, but directly useful in weeding out the weak and

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foolish, leaving room for the "deep-lunged children of the fatherland"?

Strength comes from surmounting difficulties, weakness from being helped over them, or from being unable to conquer them. Is such strength or weakness inherited? If not, much that has been written on social pathology and degeneration must be rewritten. A new history of civilization must be written, a new philosophy of ethics, and a new definition of instinct.

Is instinct inherited habit, or is it selected habit?

Is civilization the inheritance of past successes, or is "civilization a storing-up of achievements: the sum of those contrivances which enable human beings to advance independent of heredity"?

Is Neo-Darwinism the "Gospel of Despair"? The truth is never a cause of despair. What we have gained in Evolution is gained, even though the process be slower than we had supposed. This gain is the guarantee of future progress.

"It is plain that the swift spread of science has brought men into a new universe. Few there are that can adorn the new home except with ornaments saved from the old. For most men the universe science tells of rises about them unsightly and barn-like, with bare walls and naked rafters. Until art can beautify the walls, and poetry gild the rafters, men will have that appalling feeling of being nowhere at home, that awful sinking as if the bottom was dropping out of all things."—*E. A. Ross.*

Every age is henceforth to be an age of transition. In transition lies the growth of the human

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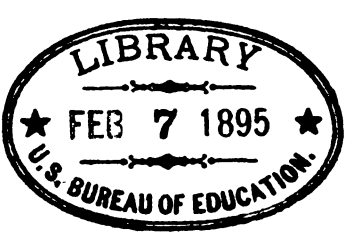
mind, which we may speak of as Nature's present purpose.

"The fathers have eaten sour grapes, and the children's teeth are set on edge. As I live, saith the Lord God, ye shall not have any more to use this proverb in Israel. Behold all souls are mine, as the soul of the father so also the soul of the son is mine. The soul that sinneth, it shall die."— *Ezekiel*, xviii, 1–3.



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LECTURE XV.

Significance of Morphology.

Prof. Frank M. McFarland.

I. Scope of morphology as a branch of biology. Its divisions: comparative anatomy and comparative embryology — the first dealing with the structure of adult forms; the second with the structural changes passed through by them in their development. Homology and analogy.

II. The most important contribution which comparative embryology has made to the science of biology is the establishment of the principle that ontogeny, the development of the individual, recapitulates in a measure phylogeny, the development of the race. Growth of this idea:

1. At the beginning of this century the fact generally recognized that the higher animals pass through stages in their development, during which they closely resemble lower forms in their structure.

2. Karl Ernst von Baer, 1828, recognized this as a general law, but insisted that embryonic stages could only be correctly compared with embryonic stages, and not with adult ones. "The more different two forms are, the farther back in their development must one go to find similar stages." Finally concludes that in earliest stages all animals may be

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similar — that "the individual development is a progressive change from a more general form to a more specific one."

3. Influence of Darwin's theory. Fritz Müller, "Für Darwin," Leipzig, 1864; Recognizes the full significance of the facts hitherto accumulated, and points out their relation as proving the theory of descent. The developmental processes of the individual a more or less complete recapitulation of the developmental history of the species, complicated and shortened by secondary variations due to adaptation, which have been acquired in the struggle for existence.

4. Hæckel's "Biogenetisches Grundgesetz"; "Die Ontogenie ist eine kurze wiederholung der Phylogenie."

III. Complications of the embryonic history to be distinguished.

1. Palingenetic characters which indicate ancestral structure; *e. g.*, the gill and aortic arches of vertebrates.

2. Coenogenetic characters, which have arisen as larval or embryonic modifications; *e. g.*, the nauplius stage of crustacea.

The principle of acceleration.

IV. Examples.— The trochophore larva of mollusks and annelids; its relations to the cœlenterates. The larval history of balanoglossus and the ascidians. Common stages in the vertebrate group as indicating genetic relationship.

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LECTURE XVI.

Ontogeny and Phylogeny.

Correspondence between geological and embryological succession. Agassiz.

"Life history of the individual an epitome of the life history of the race."— *Hæckel.* "Unter jedem Grab liegt eine Weltgeschichte." Why is this so? Repetition of organs by law of heredity. Modification by natural selection.

Significance of gills in man; of pineal eye; of valves in blood vessels; of rudimentary organs; of inguinal hernia. Segmentation of mammalian egg. Simian characters seen in childhood. Human body full of degenerate organs. "Pensioners retained for the good they have done." Advancement in one organ necessitates degeneration in others. Change in human body perpetual. Advancement of brain, hand, pelvis, great toe, etc.; degeneration of wisdom teeth, ear muscles, lower jaw, little toe, etc. Embryology reveals history of race. Embryo of animal tells its ancestry; outside, its environment.

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LECTURE XVII.

Contemporary Evolution of Man.

Prof. Frank M. McFarland.

Studies of Prof. Osborne.

I. Anomalies.— Variation at birth from ordinary or typical form. Evolution the accumulation of anomalies in a certain definite direction by heredity. The anomalous condition of one generation becomes the typical form of a succeeding one. Variation in the human body universal.

II. Comparative anatomy and embryology the key to the explanation of man's structure. The only interpretation of our bodily structure lies in the theory of descent from some ancestral form such as may have given rise to the living anthropoidea.

III. Continual readjustment of organs to suit changing circumstances. Development. Balance. Degeneration. The steps in degeneration. Variability as an adult structure; as a fœtal structure. Percentage of variability and absence increases until the organ appears only occasionally as a reversion, and then disappears entirely. Intermixing of races tends to check the rapid evolution of man.

IV. Skeletal variations.

1. The backbone. (*a*) Increase of spinal curvatures. The upright an acquired one. Ratio of front

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to hinder faces of lumbar vertebræ: negroes, 106 : 100; whites, 100 : 96. (*b*) Shortening and widening of centra of lumbar vertebræ. (*c*) Correlated changes in lower ribs, lumbar vertebræ, and pelvis. Decrease in the number of ribs. Decrease in the number of lumbar vertebræ. Shifting of pelvis. (*d*) Variation in coccyx.

2. The skull. (*a*) Closure of cranial and facial sutures in higher and lower races. Open cranial and closed facial sutures associated with increased brain action. (*b*) Teeth. Dental formula of man: I., 2-2; C., 1-1; P. M., 2-2; M., 3-3. Macrodont: Andamanese, Melanasians, Australians, Tasmanians. Microdont: Europeans, Egyptians. Mesodont: Chinese, Indians, Malayans, Negroes. Decrease in number and size of teeth. The third molars degenerating.

3. Appendicular skeleton. (*a*) Shoulder girdle and upper arm. (*b*) Variation of scapular index. (*c*) Torsion of humerus. (*d*) Obliquity of elbow articulation. In the evolution of man the lower end of the humerus has gradually twisted outward, turning the hand to the front, extending its range and adapting it to a wider usefulness. (*e*) Intercondylar foramen. Thirty per cent. skeleton of reindeer period; twenty-four per cent. skeleton of Dolmen period; five and one-half per cent. skeleton of Parisian cemeteries, fourth to tenth centuries; three and one-half per cent. skeleton of present time. (*f*) Supracondylar foramen. (*g*) The os centrale of the wrist. (*h*) Variation in pelvis. (*i*) Third trochanter of femur. One per cent. in European; fifty per cent. in Sioux; sixty-four per cent. in Laplanders; thirty-seven per cent. in Swedes. (*j*) Degeneration of foot.

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V. Muscular variations. The law of muscular evolution. Specialization by the separation of new independent contractile bands from the large fundamental muscles. Muscular degeneration leads to formation of non-contractile ligaments.

Muscular anomalies. (1) Palæogenetic reversions; complete restoration of lost muscles. (2) Neogenetic reversions; revivals of former relations in existing muscles. (3) Progressive variations; pointing to future type by specialization, or degradation. (4) Fortuitous variations. (*A*) In upper limb. (*a*) Flexor longus pollicis and flexor digitorum. (*b*) Palmaris longus. In infants and lower races. Increase of muscles in lower arm and hand, and the consequent specialization. (*c*) Retrogression in muscles of shoulder and upper arm. (*B*) In lower limb. Muscles of foot.

VI. Centers of variability; while variation is universal, it rises to a maximum in those regions of most active evolution. In man these centers are in the forearm and hand for the muscular system.

VII. Particulate inheritance, and correlated variation.

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LECTURE XVIII.

The Gastræa Theory of Hæckel.

Prof. Oliver P. Jenkins.

There have always been attempts at classifications of animals and plants, with a view to bringing order out of the confusion that their immense variety of forms present to us when their relations are not perceived.

The Point of View of Linnæus.—That of seizing upon certain resemblances found in the external form, selected with the view of conveniently throwing a large number of forms into a few easily recognized groups, but having no reference to either general plan of structure or community of descent.

The Point of View of Cuvier.—That of structure. The comparative study of the structure of animals led to the conception of the "doctrine of types," in which relationships took no account of community of descent.

The *theory of descent* introduces a wholly new point of view for the consideration of organisms. That similarity in form which is expressed by the term *homology* has a much greater significance under this theory.

The theory of descent immediately gave an immense impetus to embryological investigation as a means of

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Table of Parallelism of Ontogeny and Phylogeny.

Definition of the *forms* of the first five stages of the development of the animal body.	ONTOGENESIS. The first five stages of the individual development.	PHYLOGENESIS. The first five stages of the phyletic or historical development.
First Stage of Development. A simple cytod (a plastid without a nucleus).	1.— Monerula. Animal egg without a nucleus (when the egg-nucleus has disappeared, after being fructified).	1.— Moneron. Most ancient animal Monera, originating by spontaneous generation.
Second Stage of Development. A simple cell (a plastid containing a nucleus).	2.— Ovulum. Animal egg with nucleus (a simple egg cell).	2.— Amœba. Animal Amœbæ.
Third Stage of Development. A community (an aggregation of identical simple cells).	3.— Morula. (Mulberry Form.) Globular heap of homogeneous "cleavage spheres."	3.— Synamœba. An aggregation of Amœbæ
Fourth Stage of Development. A solid or bladder-shaped, globular, or oval body, *composed of two kinds of different cells;* externally ciliated, internally non-ciliated cells.	4.— Planula. (Ciliated Larva.) Many-celled larva without mouth, composed of different cells.	4.— Planæ. Many-celled primæval animal without mouth, composed of two kinds of different cells.
Fifth Stage of Development. A globular or oval *body with simply intestinal cavity and mouth-opening. Body wall composed of two layers;* an externally ciliated ento-derm (dermal layer), an internally non-ciliated ento-derm (gastral layer)	5.— Gastrula. (Larva with Mouth.) Many-celled with intestines and mouth; intestinal wall with two layers.	5 — Gastræa. Many-celled primæval animal with intestine and mouth; intestinal wall with two layers (Primary form of zoophytes and worms.)

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determining the true phylogenetic relationships of animals.

Through embryological study the doctrine of the origin of all organisms from a single form was first put on a firm foundation.

Review of the most important embryological discoveries pointing to this demonstration made by many embryologists.

Hæckel first formed these facts into a theory, which he called the Gastræa Theory. Statement of the theory as formulated by Hæckel. (See Table on page 41. The table is taken from *History of Creation*, 1880.)

Illustrations of the gastræa theory in the development of sponges, jelly-fishes, star-fishes, worms, arthropods, and the different branches of vertebrates.

The gastræa theory in the light of more recent investigations. Difficulties presented which it does not adequately solve.

Other theories which have been proposed to meet these difficulties.

The great influence of the gastræa theory on embryological study. Its value judged by the results of this influence. Its relation to vertebrate embryology.

The relation of embryological investigation to theories of development.

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LECTURE XIX.

The Origin of the Eye.

Prof. Oliver P. Jenkins.

The senses and sense organs as illustrations of gradual development of very complex processes accomplished by very complex organs out of very simple ones.

General view of sense organs of vertebrates. The essential elements. The accessory parts.

Illustrated in more detail by the human eye and vision. Outline of the eye, optic nerve, and visual centers.

The Eye. — Essential: Retina and optic nerve. Their elements. Accessory: Choroid and iris; sclerotic and cornea; humors and lens; muscles and nerves; conjunctiva and lids. Brief statement of functions of each.

Development of the eye in an individual vertebrate. (Ontogeny.)

Outline of the development of the germinal layers. The formation of the neural canal. The budding out of the optic vesicles, and a history of these to the formation of retina and the optic nerve. Formation of the accessory parts.

Differences in development of eyes of fish, frog, lizard, bird, mammal.

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Eyes of invertebrates. Great range of structure. What constitutes an eye. Simplest eye. Pigment spot with nerve fibers. Eye of *Nais*.

Eyes of mollusks showing series of increasing complexity; of the limpet; of the abalone; of the snail; of the squid. Development of eyes of mollusks. The more highly developed passes through the stages represented in the lower forms.

Eyes of insects. Simple. Compound.

All eyes alike in that they consist, in the essential parts (retina and nervous elements), in a number of epidermal cells with long internal processes — the one specialized for being affected by light, the other for the conduction of impulses thus generated, and further in having other epidermal cells developed into groups, in intimate relation with these, the visual centers. The meaning of accessory parts. The properties of protoplasm. The physiological division of labor illustrated in the organs of vision.

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LECTURE XX.

The Origin of the Ear.

Prof. Oliver P. Jenkins.

The auditory organ. What we learn through it.

Outline of its structure. External ear. Middle ear. These two are accessory organs. Their functions. Internal ear. Position and relations of the auditory cells and the auditory nerves fibers. These are the essential parts.

Outline of the development of the human ear. Its development compared with that of the eye. Origin of the essential elements out of the upper germinal layer.

The ears of vertebrates; that of birds; of reptiles; of batrachians; of different kinds of fishes. Each of these compared with the human ear.

In the development of the human ear successive stages are reached comparable to a series of ears of lower vertebrates.

Auditory organs of vertebrates. Their diversity in form and location. Their community of origin from the outer layer of cells (epidermal).

Organs of sense of smell, of taste, and of touch examined briefly as to their structure and development.

Each shows that the essential elements have arisen from the outer layers of cells.

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Recent discoveries in regard to the sense cells and sensory nerve fibers in the common earthworm.

A comparison of these scattered sense cells and fibers to those of the organs of special sense.

The origin of the sense organs as the result of high differentiation, and specialization of cells of the epidermis which are uniformly alike. A further illustration of the principles of physiological division of labor.

The relation of the subject of the origin of the sense organs to that of the origin of the senses, and of the origin of all that depends upon the senses.

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LECTURE XXI.

The Law of Individuality.

No two individuals exactly alike. The "divine initiative" in the individual which prevents it from being a slavish copy of any who have gone before. Intensified by specialization of parts, as it gives play for more perfect division of labor, for greater play of variation.

Every advance gives room for more protoplasm. "There is always room for the man of force, and he makes room for many." The world is never full of life, for there is always room for something better adapted to each set of its varied conditions.

Individuality produced by:

1. Double parentage.
2. Division of hereditary material in ova and spermatozoa; formation of polar bodies, Nature's contrivances to insure variation.
3. Law of acceleration and retardation.
4. Law of use and effort; effects of self-activity.
5. Variation in environment; little direct effect except through its effect on self-activity, and through the weeding-out process of natural selection; destruction of the unadapted.
6. Other laws not yet understood.

Survival of the fittest dependent on existence of the fittest. "Origin of the fittest" a difficult and, in some degree, unsolved problem.

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LECTURE XXII.

The Struggle for Existence.

No one doubts it; no one realizes it. More born than mature; all live who can; all destroyed who cannot meet the conditions; the killing never indiscriminate.

Law of Malthus (Thomas Malthus, 1798: "Principles of Population"). Man tends to increase in geometric ratio; food supply in arithmetical ratio. Criticisms of this law as a partial truth. Darwin's application of this law to animals and plants. Any rate of increase in a limited world leads to a struggle for existence. Ratio of increase of minor importance, for all geometric progressions in time outrun all arithmetical progressions. Those increase who do not live "beyond their income," the rest perish.

Herschel's observation on man. Not hard matter enough in the earth for the bones of the men that might theoretically be alive.

Increase of protozoa. Bacteria would fill sea in a month. Rate of increase of codfishes; of sparrows; of elephants; of man; of flies. "Three flies will devour a dead horse as quickly as a lion."—*Linnæus.* One hundred trillion flies in the world today; in three months one pair would produce as many. Should each fly have the most favorable environment no one could escape the plague of flies. Ten million birds in England; fifty million birds and birds' eggs die every year, and of this destruction no traces seen.

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A time of final equilibrium, a peace which is apparent, not real, and changed with a breath ; rhythm of adaptation.

No permanence in this ; present conditions but phases of change. Small events change current of affairs. Seasons return, or appear to return, because conditions return. Conditions never return in the world of life.

When increase ceases, extinction may begin.

Disappearance of Species.— Auk, Labrador duck, sea cow, passenger pigeon, buffalo. Dependence of species on species. Clover dependent on cats ; on New Zealand bees ; seal, salmon, and otter ; carp and canvas-backs.

Types hardened or sifted by struggle as against others. "The Yankee in King Arthur's Court" ; "The Scheezicks" ; "The Man Who Would Be King."

Substitution of Species.— Rats, flies, and water-cress in New Zealand. Rabbits, foxes, thistles, in Australia.

Domestic Animals and Plants.— Species or races made by man. Man changes conditions, and Nature makes these forms. Races of dogs, sheep, horses, pigeons, fruit. Goodale's observation. Along lines of variation anything possible with time and patience. Pigeons : pouter, carrier, fantail, tumbler, frill-back, owl. Each fancier sure of separate origin of the variety he rears. Somerville ; sheep chalked on a wall. Youatt ; magician's wand. Species never return unless conditions return. Solid-hoofed pigs ; Ancon sheep. Porto Santo rabbits. Power of time, by addition of increment of many generations. Species never return to original type unless all conditions return.

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LECTURE XXIII.

Response to External Stimulus.

"There was a child went forth every day,
And the first object he looked upon, that object he became,
And that object became a part of him for the day or a part of the day,
Or for many years or changing cycles of years.

"The early lilacs became a part of the child," etc.
— *Walt Whitman.*

The environment always present; always varied. Every living being affected by it. Constant pressure counts. "Nature and Nurture." "Schadet nichts im Entenhof geboren zu sein wenn man in Schwanenenei gelegt ist."— *Andersen.* "At the feet of the strong god, Circumstance." How much of our actions apparently our own are but the ordinary result of environment on the average man. Are nations and men creatures of circumstance? In large degree yes, but the worthy and the noble in some sense create their own environment.

The effect of environment shown in our regard for agriculture; for education; for training of men, and horses, and trees. Evil effect of evil surroundings. The slums beget slums. In the ideal conditions no evil environment should be tolerated.

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But the effect of environment is not direct. Else would affect all creatures alike. Environment can only affect the individual as it stimulates, limits, or diminishes its functional activity. Similarly medicine accomplishes nothing, except through effect on functional activity.

Superiority of man to environment.

"Count me o'er earth's chosen heroes; they were men that stood alone."—*Lowell.*

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LECTURE XXIV.

Natural Selection.

Darwin's phrase synonymous with Spencer's term, "Survival of the fittest," in the struggle for existence. Fittest under the peculiar conditions. Nature no respecter of persons. Not necessarily best or most specialized. But so in long run; through human reaction. Illustration of a swimmer lost through helpfulness. In long run he who brings sunshine and freedom to others receives sunshine and freedom from others.

"With much the same result as that which the farmer obtains by selecting his seed corn, the gardener by thinning out his beds, or the cattle raiser by selling off his roughest calves for veal, Nature is at work on an inconceivably great scale, thinning out the least perfect individuals of each species."—*Bergen.*

Illustrations. Rabbits, grey, brown and white; weasels; owls; bears; ptarmigans. Colors of fishes: surface colors; zone of olive green algæ; zone of red algæ; zone of inky darkness; phosphorescent spots. Birches of Norway. The Hrse series. Evolution of lungs and swim-bladder.

Mimicry; use of insignificance. Recognition marks. Division of labor. Sexual selection. Preference of females for bright colors; bright colors go with strength. Questions unsettled.

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Everywhere apparently perfect adaptation; never wholly perfect, because still more perfect may come. Change of habitat of animals or plants. Every animal and every plant is trying to extend its range in all directions. Each species would cover the world were it not that barriers prevent. These barriers may be mountains, rivers, or seas; barriers of nature; cold, heat, dryness, or storms; barriers of climate; opposition of other species already occupying the ground; barriers of the struggle for existence.

Natural selection perpetually going on. Perpetual better adaptation to conditions. Conditions change and change adaptations.

Relation of natural selection to progress. No "innate tendency toward progression." No progress where adaptation is perfect. Arises from organic dissatisfaction. Where no reason for change, no progress. Withdrawal from the struggle for existence means degradation. The bulk of living forms makes but slight advance.

"Whatever is desirable becomes necessary as soon as it is possible." Whatever becomes useless disappears by degrees.

Subliminal Consciousness. Its possibility. The present range of consciousness even in the finest man is small. All things we know are relative. We recognize a certain range in sound, color, size, force. Everything comparative and lying between two infinities. The universe and the ahnenplasma. "Every meanest day the conflux of two eternities." "Time as long as space is wide." "To look before and after" in some slight degree, a result of human specialization. Even

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specialization is a comparative thing. The simplest infusorian a wonderfully complex thing by the side of primitive life. Compared even with the infinite future of finite mind, man may be a fragment of undifferentiated cosmic dust. "The largest son of time that wandered singing through a listening world will be as much forgot as a canoe that crossed the bosom of a lonely lake a thousand years ago."

Does natural selection, with its associated laws and forces, explain the origin of species? Open questions.

Intensification of fishes in tropics; of men in cities; of butterflies; specialization of parts accompanied by proportionate degradation of other parts.

Obscure Applications of Natural Selection.— Equality of numbers of the sexes; division of labor between sexes. Limitation of size. Length of life. "Touches all things mortal with cold immortal hands." Pain a necessity of sensation, an associate of will; both outgrowths from motion and locomotion. Mind (as distinguished from reflex nerve action) itself a reaction in organisms "sore bestead by environment." Power to change environment necessitates sensation and will. From these follows pain. Susceptibility of pain greatest in those having the greatest capacity of power. Suffering a "baleful legacy" from specialization; power to do and power to enjoy. The index to high development.

"Can it be, O Christ in heaven,
That the highest suffer most?
That the strongest wander farthest
And most helplessly are lost?"

Why this must be true.

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Immortality and insignificance exchanged for specialization and pain.

Specialization implies dependence.

Differentiation goes with integration.

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LECTURE XXV.

Natural Selection and Ethics.

Natural selection a world process without ethical quality in itself. As gravitation brings about physical order, so natural selection brings about organic adaptation. It can be no respecter of persons, can grant no justice but its own.

A fallacy which dies very slowly is the idea that Nature's operations execute human justice. "Rain falls on just and unjust."—*Luke*, xiii. Tower of Siloam. The Galileans whose blood was mingled with the sacrifices. "Earthquakes; their cause and cure." It is only in human reaction from Nature's processes that a moral element comes in. Gravitation makes men upright. Natural selection in the long run favors those who help others.

At first a premium placed on egoistic qualities. Man succeeds because of the ape and tiger qualities. But ape and tiger have rudiments of justice, else they could not hunt in bands. Need of fair play the base of ethics.

"Nature does not cosset nor pamper us. Providence has a wild, rough, incalculable road to its end. It is of no use to try to whitewash its huge mixed instrumentalities, or to dress up that terrific benefactor in the clean shirt and white neckcloth of the student of divinity."—*Emerson*.

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Much of the misery of the world due to the belief that Nature will somehow make an exception in our favor. That she will somehow ease up on her laws when she comes to our case. Belief that Nature can or ought to interfere in the interest of easy living.

But the forces of Nature and laws of Nature each one its own justice, and no other. Nature no respecter of persons. How could she be? Moral indifference of Nature. How could Nature be morally other than indifferent? Moral indifference of multiplication table. Nature's laws differ from multiplication table in being more complex, not more variable. Two times two equals four the world over. But we count that ten thousand dollars at compound interest should yield more for a good cause than a bad one. So it will in the long run; not through the multiplication table, but through human reaction.

Bad men think that they can trick a complex law; good men that they can bend it to help them. Both are deceived. A varying multiplication table: destruction of science. Varying law: the destruction of the universe.

"If God should wink at a single act of injustice the whole universe would shrivel like a cast-off snake-skin."

Laws of Nature best, else they would not be. A broken law would be a discarded universe.

Ruskin on the "Pathetic Fallacy." Basis of poetry. Superstition grows out of poetry taken literally by the unpoetic. Illustrations:

> "They brought her home across the foam —
> The creeping, crawling, cruel foam."

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"Thou, O sea, stern mother of my soul."

"Day by day the sunlight glittered on the vacant, smiling seas."

"The rushing, incurious billows."

But billows are neither cruel, stern, nor smiling.

"Nature red in tooth and claw,
From scarped cliff and quarried stone.
She cries, a thousand types are gone.
I care for nothing, all shall go."

Bounteous Nature
"Loves the grass green meadows,
The grazing kines sweet breath."

"Her just keeping on the same, calmer than clock-work, and not caring,
Nor finding anything to blame, is worse than if she took to swearing."

Modern Pessimism.— Failure to recognize perfect and necessary justice of natural law, and that ethics belongs to *human reaction*, itself a necessary law, but separate.

Law of Heredity.— Repeats evil and good. The past cannot let go of us, nor we of it. Conservatism in life.

Law of Gravitation.— Drowns a prophet or a rat. Brings cosmic order.

Law of Mutual Aid.— Giving may cause or perpetuate misery as well as create strength.

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Law of Self-Activity.— Wolves and devils enjoy their calling. Wicked flourish like a green bay tree. Not wickedness, for this conflicts with human reaction.

Law of Sensation.— Carry pleasure, pain, sorrow, alike. Pleasure; pain a warning of injury or degeneration. Nature tempers the wind to the shorn lamb — allows pain to cease when useless.

Laws of Nature not good nor bad, but true. Nevertheless goodness lasts and wickedness fails. "God consents, but only for a time." "God's errands never fail." "What God does for man he does through man."

Thus arise the laws of *human reaction*, from which comes human justice. The impulses that "make for righteousness." Slowly, wastefully, but surely comes the growth of ethics from human reaction.

Why God's errands never fail.

In two ways at least:

Through Human Help.— The bank of human kindness. Those who bring sunshine and freedom into the lives of others cannot keep it from themselves.

Through Self-Help and Self-Devotion.— Power of earnestness and devotion.

The strength of prayer. Sempach: Marston Moor. Thy will be done, and let my will be a part of it.

What if prayer will not bring rain, or make a crop, or have no money value? Its value to you. Pentecost's remark.

"The essence of prayer is to bring two things into unison — the will of God, and the will of man. Superstition imagined no doubt that prayer would change the will of God; but the more spiritually-minded have always understood that the will which must be

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modified in prayer was the will of man."—*Bernard Bosanquet.*

Strength of John Brown. "The gamest man I ever saw," the governor of Virginia said.

"Nobody sent me here. I obey only my own impulses and those of my maker. I acknowledge no master in human form."

"Let no man trouble me. I bear on my body the marks of the Lord Jesus."

"Careless seems the great avenger, history's pages but record
One death grapple in the darkness twixt old systems and the Word.
Truth forever on the scaffold—wrong forever on the throne;
But the scaffold sways the future, and behind the dim unknown
Standeth God within the shadow, keeping watch above his own." —*Lowell.*

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LECTURE XXVI.

Law of Self-Activity.

Progress of Evolution through interaction of partially opposed forces. Regular movement could not spare either. Variation and heredity; Nature and nurture; change and conservatism; egoism and altruism; coöperation and individualism. Law of mutual aid, and law of self-activity.

Nature a thrifty investor; withdraws all unused investments. Parable of talents. Branch in which no sap moves dies. Unexercised functions disappear in the individual. The organs atrophy. So in the race. What is latent long, atrophies by degrees. Nature changes her plans as conditions change. Heredity causes her to remember them. Pineal eye. Gills. Environment affects the individual chiefly by modifying local or general self-activity. What comes out of a man determines his life. Learn to do right by doing right.

1. Self-activity the cause of individual progress.

2. Cause of specific acceleration. Is it inherited acceleration? Or does Nature favor those who use their powers as against those with equal powers unused? Are use and non-use hereditary, or not?

3. Source of happiness. Enjoyment of life. Misery comes from lack of self-activity.

Causes of personal degeneration:

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1. *Ennui*, the pressure of existence, unvisited by effort. "The very fiends weave ropes of sand rather than taste pure hell in idleness." Spiritual pauperism a phase of decline. Lady Clare Vere de Vere. Galton on the English peerage. Sickness or injury not necessarily the causes of ennui. Darwin; Tom Dunstan.

2. *Dissipation.*— Passions which burn and burn out. Deceptions of the senses. The "pleasures like poppies spread," are not pleasures, but tricks on the nervous system. These destroy it; their results phases of degradation. "The world looks different to the man, and he looks different to the world." These subjective imaginary pleasures followed by horrors which are equally subjective. Alcoholism; opium; narcotism; sensuality; trances. Pessimism largely result of affected sensorium. Religious excitement. Nature favors the creature which looks with clear eyes on its surroundings. "Who ever with a frolic welcome takes the thunder and the sunshine."

3. *Slavery.*— Dragging down of effort without the element of consent. No virtue in hard work, but work to a purpose. Work without a pride in it tends to degradation. Tendency to drown evil feelings arising from degradation in self-deceiving stimuli, which tend in the same direction. Even a slave need not work slavishly.

4. Old age.

5. Evil associations.

6. Arrested development.

Natural selection destroys those who find no pleasure in action; for such do not act. Natural selection eliminates the victims of ennui, dissipation, or slavery.

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Happiness comes from exercise of functions in any grade; overcoming of opposition; doing good to others; conquests of mind; love of friends. All happiness is positive and strengthening.

Athletics; war; exploration; study; mountaineering. No man engaged in positive exercise of functions, either high ones or low ones, ever complained of ennui. Ennui means that dry rot has set in. It is Nature's means of telling us so.

"Most of the vice of the world is vice of corrosion." — *G. S. Hall.*

Greek philosophy: "Though life be sad, there is joy in the living it." Those who *do* are paid as they go. Hamlet; content only in action.

Thoreau's "word for freedom and wildness." "O, to have passions like these." Myron Wilkins. "The man that had a sore heel on the tramp always remembers it with a grin."— *Myron Reed.*

"By the brand upon my shoulders,
By the gall of clinging steel,
By the welt the whips have left me,
By the scars that never heal,
By the eyes grown old with staring
At the sun-wash on the brine,
I am paid in full for service,
Would that service still were mine."

— *Kipling.*

Freedom; a fundamental need of human beings for their own development.

Its limitations; bounded by mutual aid.

William Watson's "Dream of Man."

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LECTURE XXVII.

Law of Mutual Help, or Altruism.

1. Shown in conjugation of cells. Hence arises division of labor between the sexes. Conjugal love. Filial love. Parental love. Formation of the family. Source of variation.

2. Shown in the aggregation of cells. Hence arises compound animals. Specialization. Physical division of labor. Source of variation.

3. Shown in altruism. Qualities that bind men and animals together in tribes or nation. Live and let live rising to live and help live. From the Silver Rule to the Golden Rule.

Progressive ethics.

From the basis of altruism rises human justice, religion, science entering into the work of others.

Altruism. Mutual help in the three-fold struggle—against forces of Nature; against others of unlike character; against others of like character.

Civilization essentially security against violence in the struggle for existence, enabling us to enter in work of the others of the past as well as of the present.

The animal virtues giving way to the Christian virtues. Rights of others. Rights of lower animals. Bayary Taylor's story.

A bounty on Cain. Ishmaelites. Our strength drawn from others.

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"No man is great till he can see
How less than little he would be
If all alone and stark and bare
He hung his sign out anywhere."— *Riley.*

Will altruism do away with the struggle for existence? Can we save all the waste of competition by coöperation? Can do little more than do our own duty, and work for civic freedom, justice, and honesty. Evolution moves slowly. The world never moved by dynamite, nor lifted by boot-straps.

Loss in altruism. Mutual help induces mutual dependence. The self-sufficiency of single all — the independence of Robinson Crusoe. Weakness of civilization. But this price must be paid for the advantages. Specialization goes with integration; that with mutual dependence.

Degradation of coöperation.

Hydroids. Corals. Sponges. Portuguese man-of-war.

Wherever there is no premium placed on variations nor on superior self-activity, degeneration sets in.

New Harmony. Icaria. Kaweah. Bellamy's plans. All colonies must fail where men reap who have not sown; where rewards come alike to the active and the idle, the bright and the dull; where drones and workers have equal access to the honey cells. Each man must be responsible for his own destiny.

Marriage by official selection. Life of official permission. Failure of socialistic attempts through seeing half-truths only. Law of self-activity must not be impeded by law of help.

Future possibilities of altruism. Tendencies towards state socialism. Dangers.

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LECTURE XXVIII.

The Origin of Goodness.

Prof. Edward A. Ross.

Right-doing may have any one of many motives. No mystery when prompted by fear, dread of punishment, hope of reward, love of praise, pride, vanity, worldly prudence, confusion as to one's own interests, force of conventionality, or habit. Only when such motives are wanting do we ascribe goodness.

Right-doing is outward, and means conduct looking to the well-being of others. Goodness is inward, and means making the welfare of others our interest — joy in another's joy, pain in his pain. The springs of our action come to lie elsewhere than in ourselves. We say in effect: "Thy ill is my ill, thy weal my weal, thy ends are my ends." Goodness amounts to altruism, or otherness, which in turn implies sympathy.

The origin of otherness the great mystery of human nature. Selfness or egoism easy to understand, but altruism challenges explanation, seems unnatural. Can there be soul nerves? Some even deny that pure altruism exists.

The romantic explanations. Is union or separation our primitive state? Plato. Kant and the "Ding an Sich." Hegel's "Absolute." Schopenhauer. Hartmann's "Unconscious." Emerson's "Oversoul."

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"One central fire glows in all." "Parts of a single continent."—*Matthew Arnold.* The heaven before individuation. Sympathy a reminiscence of the soul's ancient estate. We are Brahma fallen into multiplicity, and hence into selfishness and sin. Sympathy recognizes our underlying oneness—intimates the identity of all life. "*Tat twam asi.*" The self transitory. The I is an ice crystal born of the All, and destined to melt into the All. We are from the One *en route* to the One. Sympathy a reminiscence and a prophecy.

"Some little talk awhile of *Me* and *Thee*,
There was—and then no more of *Thee* and *Me*."
—*Omar Khayyam.*

The explanation from Evolution. The individual came first—no primeval soul-plasm—consciousness of self preceded consciousness of others. Egoism older than altruism. Man not fallen from unity into multiplicity, but rising from multiplicity to unity. Sympathy a derivative feeling of practical origin—in no wise supernatural or mystical—developed by the cosmic process of selection through struggle. The moral paradox.

Sub-human altruism. Family cohesion—love, maternal, sexual, paternal. Group cohesion in gregarious species—ants, bees, rooks, wolves, deer. Such altruism developed and limited by natural selection, instinctive, irrational, inconsistent.

Human altruism. Vast changes with growth of intelligence. (1) Range of sympathy widened with greater power of interpreting signs of feeling. (2)

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Altruistic impulses developed into moral rules or principles. (3) Society in its own interest curbs selfishness, and stimulates self-sacrifice by ethical codes and religions and moral ideals.

Simple ethical forms. Love, hate, sympathy, pity, malice, generosity, greed, revenge.

Derivative ethical forms. Sense of honor, of duty, of sin, conscience, remorse, repentance, self-renunciation, self-mortification, contrition, atonement, justice, veracity, honesty.

Altruism and our duties to others. Mother love, conjugal love, filial affection, claims of kindred, caste and professional spirit, *esprit du corps*, loyalty, patriotism, civism, philanthropy, humanitarianism.

The so-called duties to self. Partly altruistic — cleanliness, decency, chastity; partly egoistic — temperance, self-control, abstinence from suicide; partly esthetic — abstinence from sensuality, brutishness, gluttony, filthiness, uncouthness, slovenliness.

The foundations of altruism. Shall we give a cup of water to the thirsty wayfarer for the sake of a reward in this life — "casting bread on the waters"; or in another life — Mohammedan paradise; because it is God's will — the "Commandments"; from a sense of duty — "Categorical Imperative"; for the sake of some one we love — "in His name"; or for the sake of the wayfarer himself?

The justification of altruism. Whence flow our chief miseries. How men torture each other. Each can inflict more injury than he can ward off. Egoism leads to collision, strife, wounds, pain, and disappointment;

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altruism leads to harmony, joy, coöperation, peace, contentment, and social health.

The greater abounding of altruism. We err on the side of egoism. Our natures more altruistic than we think. We gain prosperity, but lose peace of conscience. What men live by. In what riches consist. Opulence in love.

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LECTURE XXIX.

Degeneration.

Meaning of high and low in biology.

High may mean: complexity of structure in general; complexity of special structure; complexity of nervous organization; adaptation to complex environment.

Man the highest animal through complexity of nervous system and derived powers of will, self-activity, coöperation, speech, and abstract reasoning. All the product of emphasis laid on living by his wits. But specialization of one or many parts implies deterioration in others, as the ape-like strength and spryness are little needed by man. Degeneration of single organs as their highest functions become useless. A law of Evolution. Example: pineal eye; jaw and jaw muscles; gills in mammals and birds. Strength in simplicity; in government; in education; in language.

Degeneration is decline in rank. Takes place whenever the struggle for existence permits life on a lower plane of activity or of adaptation.

1. May take the form of adaptation to less complex surroundings, as in the seal, or blind fish. Then accompanied by specialization in minor structures.

2. Reduction of vigor. Preliminary to extinction.

3. Simple divergence, from isolation and narrowed range.

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4. Reduced self-activity, and simultaneous withdrawal from struggle for existence. Examples: Parasites, quiescent animals, compound animals.

Distinction of degenerate forms from forms primitively simple. Used up potentialities. Myrick's law of lost organs.

Degeneration and extinction of too highly specialized forms; Dionæa compared with Drosera.

When individual self-activity is lowered, and conditions of environment are such that destruction does not set in, we have conditions of continuous degeneration. Origin of degenerate forms shown by embryology. For the individual in its development goes over the whole road, be it upward or downward.

Amblyopsis, the blind fish, descended from *Chologaster*, the fish of the Dismal Swamp. Deep sea fishes. *Typhlogobius*, the blind goby of Point Loma.

Tunicates, and their fish-like young.

Sacculina, and its crab-like progeny. Born as a young crab, but, living at the expense of others, loses self-activity, but is not destroyed in competition, and is degraded into a parasitic sac, with no organs except root-processes, ovaries, and brain. Further degradation of male sacculina.

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LECTURE XXX.

Degeneration in Man.

Possible to breed human sacculina by same methods; shelter from destruction, remove incentive to individual action, and allow unfitness to mate with unfitness.

Cretinism in Valley of Aosta. Elements. Military selection; heredity susceptibility to goitre; influence of indiscriminate charity whereby the worst fares better than the best.

Pauperism. Analogy to sacculina. Its existence dependent on getting something for nothing. The Lord's poor, the devil's poor, and paupers.

Dr. Dugdale's studies of the Jukes family. "Margaret, the mother of criminals." Hereditary parasitism.

McCulloch's studies of the "Tribe of Ishmael." Paupers of California, Missouri, Indiana, Illinois, Kentucky, Virginia, and the Carolinas derived from England's stock, and kept alive by public and "private outdoor relief." Origin of Georgia "poor-white trash."

Pauperism can be exterminated, as swamps are drained; not by giving, but by removal of causes. Remedies: Destruction of the slums and their social gangrene; closing outdoor relief; checking feeding of vagabonds, and indiscriminate giving; saving the

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children, and stimulating them to self-activity; cutting off the root tentacles, and making parasites self-helpful, or confining them that the generation may cease. Slums a culture-basis for moral and physical disease. Make parasitism the hardest mode of life and the most active. Sicily. Venice. Climatic effects.

The duty of charity to save the unfortunate; to permit those incapable by heredity to become extinct with the least possible suffering. Good and evil of pension systems.

No way to make humanity happier, except to make humanity stronger and better. If humanity has something to do, and does it with a pride in its work, it will be reasonably happy. Train those we have, and let heredity repeat the best, and not the worst. Slums breed slums; idlers and criminals are not the stock from which the men of the future may spring.

Charity consists in making men better adapted to environment, not in easing up the environment around individual men. "What shall we do with John Jones?" What did we do with Tom Huxley, or Mike Faraday?

"Whatever begot the charitable impulse in the first place, it survived because it was useful." — *Warner.* Survival of people and races with altruistic sentiments "a sufficient answer to those who object to all philanthropic undertakings as mischievous meddling with the benign course of Nature." "Why not be brutal?" Because brutality is barbarous; brutality is expensive. Why not let the vicious and profligate, the dirty and the diseased, exterminate themselves? Because gangrene is not a profitable caustic. "Social cancers in-

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fect more than they eat away." The slums destroy those who live in them, but infect and drag others to destruction.

"If enlightened self-interest is a good thing, enlightened self-sacrifice is a better thing. One instinct as well as the other may be misdirected and harmful, but is equally capable of enlightenment." "No race ever became extinct through excess of brotherly love." —*Warner.* Charity as fire insurance. Charity scattered as corn to catch the chickens.

"The final result of saving people from their folly would be to fill the earth with fools."—*Spencer.*

Charity as an ethical duty. Read Warner: "Ethical Aspects of the Question; Evolution of Charities" (pp. 268–9).

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LECTURE XXXI.

The Industrial Struggle for Existence.

Dr. Amos G. Warner.

I. The number of persons who can maintain a given standard of living in a given territory depends upon

1. Original resources of the district.

2. Amount and character of accumulated information. State of the arts and sciences, and the organization of industry.

3. Character of the people, especially as to physique, intelligence, and morality.

4. Amount of accumulated capital.

II. The expansibility of the civilized man tends

1. To limit population before the pathological checks of war, pestilence, and famine are operative; but

2. To maintain the struggle for existence even when there is no absolute pressure of population against the means of subsistence. If all were content with the bare necessities of life, Europe could support a population of eight hundred millions. "Progressive desire" makes it common for one man to consume what would suffice for the maintenance of thousands.

III. The industrial struggle for existence is to secure possession of economic goods. It is waged

1. Between man and natural forces, including plants and animals as a part of Nature-distinct-from-man.

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2. Between individuals, a family counting as an individual for most purposes.

3. Between classes. (*a*) Employer and employed. (*b*) The propertied and unpropertied, and lenders and borrowers. (*c*) Organized and unorganized labor. (*d*) Producers and consumers. (*e*) Races, in so far as different races live together under one government.

4. Between enterprises. (*a*) Source of variation here is often conscious effort to vary. (*b*) Between enterprises differently located. (*c*) Between enterprises differently organized: factory vs. shop; machinery vs. hand labor; coöperative and profit-sharing enterprises vs. those under "captains of industry"; stock companies vs. partnerships; etc. (*d*) Large enterprises vs. small ones.

5. Between nations. (*a*) By war — opium war. (*b*) By tariffs, bounties, and restrictions. Example of successful aggressions: English navigation acts. Example of unsuccessful aggression: German sugar bounties. (*c*) By so regulating the interval between individuals, classes, and enterprises that general and permanent interests may not be sacrificed to general and temporary gain, *e. g.*, Sunday labor, length of labor day, dangerous occupations, wasteful duplication of plant, etc.

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Studies of Darwin. Animals of the Galapagos Islands; persistence of edentates in South America.

Types persist through space and through time. Species change with either space or time. With time, because time gives rise to events which cause divergence. All divergence really dichotomous. With space, because with space come barriers which again produce dichotomous divergence, in both cases followed by isolation and segregation of characters.

Study of small variations in species. Methods of Professor Baird. Pacific railroad survey (1856–8). Mexican boundary survey.

Studies of Dr. Joel A. Allen (Mammals and Winter Birds of Florida). Species and sub-species. Known presence of intermediate forms sole test of validity of species.

Illustration: Shore-lark, *Otocoris alpestris*, and its varieties: *praticola*, *leucolæma*, *arenicola*, *giraudi*, *menilli*, *chrysolæma*, *adusta*, *strigata*, *rubea*, *pallida*.

Song sparrow, *Melospiza fasciata*, and its varieties.

Bluebird, *Sialia sialis*, *aretica*, and *mexicana*, distinct species.

Meadow lark, *Sturnella magna* and *neglecta*, doubtful species.

Flicker, *Colaptes auratus* and *cafer*, doubtful species.

My own experience with species.

The trout; Salmo gairdneri, the steel-head; Salmo irideus, the rainbow trout; Salmo mykiss, the "cut-throat trout," and its varieties: lewisi, in the Missouri; stomias, in the Platte and Arkansas; macdonaldi, in the Twin Lakes; spilurus, in the Rio Grande; pleuriticus, in Utah Basin; henshawi, in

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Lake Tahoe; bouvieri, in Waha Lake; agua bonita, "golden trout," of Mount Whitney; gilberti, in Kern River; shasta, in McCloud River; all varieties of one species; all would have been regarded fifteen years ago as good species.

Catalogue of fresh-water fishes of United States: in 1876, 670 species; in 1868, 665; in 1885, 587; now about 560, although 125 added since 1876.

Changes of species similar to changes in words in derivative languages. Thus: kerasos (Greek), cerasus (Latin), ceriso (Italian), cereso (Spanish), cerise (French), cherry (English), kirsch (German), kers (Danish), cerejo (Portuguese), and so on. Changes of *aster*, star, and other words.

Laws of change of words analogous to those of change in species. Where words come from. Where species come from. Left-over species in swamps, caves, and depths of the sea; left-over words in isolated mountain valleys. As a fauna is made up of species, which have come from many regions, so is the language made up of words carried over from many sources. Sequoia, a left-over tree. Left-over types in Australia.

The old idea of species passed away forever. Can no more return to it than astronomers to the Ptolomaic idea of the solar system. No one who knows the facts could ask us to return. Some lessons from geology. Fossil shells.

All forms diverging; no structure returns to previous stages. What are intermediate forms? "Missing links?" Link between horse and cow? Not a cow-horse, or a horse-cow, but something far more primitive than either, with the character of neither. This now recognized in the extinct coryphodon.

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LECTURE XXXII.

Isolation as a Factor in Evolution.

Barriers separating forms permit them to differentiate. "Migration holds species true, localization lets them slip." Compare the local variations in forms in California with those in Mississippi Valley. Much greater number of varieties, fewer forms.

Compare races and dialects in Europe with those in America.

Physiological segregation. Peculiar forms so separated as to despise each other. Tendency towards sterility.

Race prejudices; deer; men.

Hybridism. Its value as a test of species slight.

1. Possibility of amphimixis.
2. Possibility of fertilized egg developing.
3. Possibility of resultant animal having fertile germ cells.

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LECTURE XXXIII.

Are Species Real?

"Systematic work would be easy were it not for this confounded variation, which, however, is pleasant to me as a speculatist, though odious as a systematist. . . . How painfully true it is that no one has a right to examine the question of species who has not minutely described many. . . . Certainly I have felt it humiliating, discussing and doubting and examining over and over again, when in my mind the only doubt has been whether the form varied today or yesterday. . . . After describing a set of forms as a distinct species, tearing them up and making them separate, and then making them one again (which has happened to me), I have gnashed my teeth, cursed species, and asked what sin I had committed to be so treated."— *Darwin.*

Variation of Species.— Does one species change into another? The crucial test of the theory of the formation of species by natural laws.

The old idea of species. From Linnæus's "Systema Naturæ" (1758). The idea of variety. *Homo sapiens*, the aboriginal man, and the five varieties: *Europæus*, *Asiaticus*, *Afer*, *Americanus*, and *Monstrosus*. *Homo troglodytes*, the orang-outang, a second species of man, according to Linnæus.

Fallacy of old ideas discovered by a close comparison of species. Lamarck. Darwin.

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"Missing link" between man and monkey; not man nor monkey, but something simpler than either, and with generalized characters from which either could have arisen. No living monkey likely to have been ancestor of man.

All forms diverging; those not now man never can be, for divergence has given them qualities not in line of human descent.

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LECTURE XXXIV.

Classification.

Homology the basis of classification.

Artificial Classifications. Linnæus; classes of plants on number of stamens; orders of plants on number of pistils.

Fishes whose tails move vertically, and those which flap horizontally.

Natural Classifications. Cuvier, Jussieu. Possibility of natural classification one of the strongest arguments for unity of life. All forms known arrange themselves in a way analogous to the branches of a tree. All diverge forward; traced backward they converge.

Homologies of words similar to those of animals and plants. Non-homologous languages. Chinese and English. But all languages subject to Evolution and divergence. So with all organisms.

Missing links in classification. Horse and cow not a horse-cow, but the unspecialized coryphodon. Link between whale and fishes not a whale-fish, but rather a reptile. Cats, or even man, are nearer fishes than the degenerate whales, which are degenerations from a type rudely described as bear-like or dog-like.

How change a fish into a whale? A whale into a fish? Impossible now. In any transformation we must go back to unspecialized forms, which still retain the potentialities of some other type.

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Generalized types. Embryonic types. Prophetic types. Recognized by Agassiz in the geological record.

Development of vertebrates.

Evolution and differentiation of fishes.

Why the "highest fishes first"? Confusion in the meaning of "highest."

Derivation of batrachia from fishes.

Derivation of reptiles, birds, and mammals.

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LECTURE XXXV.

Application of Theory of Descent to Taxonomy.

Prof. John H. Comstock.

Definition of the terms *generalized* and *specialized*:

Specialization by addition. Hind legs of grasshoppers. Maxillæ of lepidoptera. Pectinations of antennæ. Tracheal gills. Wings of insects.

Specialization by reduction. Loss of legs in arthropoda. Loss of mandibles in lepidoptera.

Modification of the form of parts through change in function. The swim-bladder of fish a degenerate lung. Dermal glands of insects changed into tracheæ. Tracheæ furnished by addition with tracheal gills. Tracheal gills changed into wings. If these suppositions be true, the wings of insects were derived from dermal glands.

Myrick's law of lost organs: When an organ has wholly disappeared in a genus other genera, which originate as off-shoots from this genus, cannot regain this organ, although they may develop a substitute for it. Arthropods with more than six legs not derived from the hexapoda. Insects with mouth part not derived from mouthless insects. Winged insects not derived from forms that have lost their wings.

Rapidity with which organs are lost when they become unnecessary. Wings of females of certain moths. Hence a form lacking an organ may be only slightly removed in other respects from the progenitor of forms that still possess that organ.

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LECTURE XXXVI.

Application of Theory of Descent to Taxonomy. — Object and Methods of Taxonomic Work.

Prof. John H. Comstock.

Object and methods before the acceptance of the theory of Evolution. Making of catalogues. Grouping of related forms without understanding the bond of union.

The tracing of the phylogeny of groups.

Aid derived from palæontology.

Aid derived from the study of those existing forms that are generalized in structure.

Peculiar specializations of generalized forms, "sidewise developments."

Proposed method of taxonomic work. (1) The determination of the probable form of the progenitor of the group to be classified. (2) The tracing of the various ways in which this form has been modified by descent; *i. e.*, the determination of the phylogeny of the group.

Difficulties of carrying out this plan. Poorness of the palæontological record. Hence, usually, the necessity of determining the primitive type by a study of existing generalized forms; and of determining the various ways in which this type has been modified by a study of the more specialized of the existing members of the group.

How shall one determine which are the more gen-

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eralized, and which are the more specialized members of a group of organisms?

The structure of a highly organized animal or plant, taken as a whole, is too complicated for the human mind to grasp at once. Hence the suggestion to begin with the study of a single organ possessed by the members of the group to be classified. Study the variations in form of this organ. Determine its function or functions. Trace out its phylogenetic development, *keeping constantly in mind the relation of the changes in form of the organ to its function.* In other words, endeavor to read the action of natural selection upon the group of organisms as it is recorded in a single organ. The data thus obtained will aid in making a *provisional* classification of the group.

Then another organ is selected, and its history worked out in a similar way.

The results of the two investigations are then compared, and where they differ there is indicated the need of renewed study. For if rightly understood the different records of the action of natural selection will not contradict each other. The investigation is continued by the study of other organs, and a correlating of the results obtained until a consistent history of the group has been worked out.

This method differs from that commonly employed in being a constant effort to determine the action of natural selection in the modification of the form of organisms, in order to better adapt their parts to perform their function. Ordinarily little or no attention is devoted to the study of the function of organs in purely taxonomic works.

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LECTURE XXXVII.

Application of Theory of Descent to Taxonomy. —Illustration of the Application of This Method. The Descent of the Lepidoptera.

Prof. John H. Comstock.

Selection of the organs of flight as the first organs to be studied.

Importance of wings to the lepidoptera. Chief organs of locomotion of adult. Present in all known species. Vary greatly in form; hence they have been the field of extensive action of natural selection.

The results of this action are recorded in characters which are easily read. These characters are variations in form, in the number and arrangement of the supporting "veins," in the relation of the two pairs of wings to each other, and in the nature of the clothing of the wings.

1. Variations in form and venation. Broad wings with many veins, narrow wings with comparatively few veins, and every gradation between these two exist. Which form probably represents most closely the wings of the primitive lepidopterous insects?

The wings are organs of flight; those members of the order which fly best have narrow wings with comparatively few veins; such are, therefore, probably the more specialized.

The wide-winged members of widely separated fami-

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lies agree in the possession of wing veins, which are lacking in the narrow-winged members of the same families. The media, and the third anal vein. If the narrow-winged forms are considered the more generalized, we are forced to conclude that the media and the third anal vein have been independently developed in each family where they exist, which is very improbable.

Conclusion that the primitive lepidopterous insect possessed broad wings, furnished with at least eight principal veins, including the media and three anal veins.

Conclusion strengthened by a study of wings of insects of other orders; also by a study of fossil insects.

The chief method of specialization of the wings of insects as regards their area and their venation has been by reduction. This specialization has changed the wing from an organ which acted as a kite, or a parachute, to one fitted for vigorous flight.

Origin of wings not yet satisfactorily explained. Theory of origin from tracheal gills. Theory of origin from keel-like expansions of the sides of the body segments.

Different lines of descent from the primitive lepidoptera indicated by different methods of reduction. In *hepialis* and *micropteryx* the anal area of the hind wings is greatly reduced, while the radius retains the maximum number of branches. In all other lepidoptera all of the branches of the radius disappear before the anal area is reduced. Subdivision of the groups thus formed.

2. Relation of the two pairs of wings to each other.

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Evidently the action of natural selection has tended towards uniting the two wings of each side during flight in order to insure their synchronous action. The frenulum and the frenulum hook. Compound frenulum. Simple frenulum. Structure of simple frenulum. Theory as to origin of frenulum. Sexual differences. Results of experiments with trap lanterns. Superseding of frenulum by a large development of the costal area of the hind wings. Last stages of the frenulum.

Lepidoptera which have neither frenulum nor a large development of the costal area of the hind wings. The *jugum*. Theory regarding the relation of the two pairs of wings in the primitive lepidoptera. Division of the order into *jugatæ* and *frenatæ*. This division coincides exactly with the primary division based on the relative reduction of the radius and anal area of the hind wings, as indicated above.

3. The clothing of the wings. Variations in the form of this clothing, hairs, and scales. Variations in the arrangement of the hairs or scales. Function of this clothing. Absence of cross veins in wings of lepidoptera. Determination of the more generalized form of clothing. Relative degree of specialization of scales on upper and lower sides of wings, on fore and hind wings, and on the proximal and distal portions of the same wing. Minute structure of scales. Primary use of the ribs on the scales. Secondary use of these ribs in the production of interference colors. Examination of wing of blue butterfly with reflected light and with transmitted light.

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Importance of Confirming Results Obtained in the Study of One Organ by the Study of Other Organs.

A classification based upon the study of a single organ must be considered *provisional.*

Illustration drawn from the *Saturniidæ.*

Different results obtained from a study of the antennæ, and from a study of the radius of the fore wings of the *Saturniidæ.*

Conclusion that while, as a rule, the tendency of natural selection is towards a reduction in the area of the wings, thus fitting them for more rapid flight, a condition may arise, as a high specialization of an organ of special sense (presumably an organ of smell), in which a soaring flight is more desirable. Under these circumstances selection will tend to widen the wings.

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LECTURE XXXVIII.

Evolution of Plants.

Prof. Douglas H. Campbell.

It is a mistake to suppose that the study of evolutionary problems must be confined to the animal kingdom; plants offer quite as many and equally convincing proofs of the law of Evolution.

The principal data are obtained from two sources — palæo-botany, *i. e.*, the study of fossil plants; and comparative morphology in its widest sense, that is, the study of the structure of the plant in all its parts and at all stages of its development. Embryology has given here, as in zoology, the most important clues to relationships.

Biology, the science of *living things*; not of animals alone. Botany as truly a department of biology as zoology is.

The simplest living things neither plant nor animal. Protista.

Uniformity in the ultimate structure of all living things. The perfect plant or animal all a nucleated mass of protoplasm.

Lowest forms of plants. Fission plants. Bacteria, blue-green algæ. These not closely related to the higher plants.

Volvocineæ (green monads) probable ancestors of the higher plants. Also seem related to the flagellate

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infusoria. Active, mostly bi-ciliate cells, showing both animal and plant characters.

From the active volvox cell, protococcus-like forms probably arose, unicellar non-motile cells, but reverting at times to the active condition.

Next higher in rank the confervoid algæ. These may have arisen from protococcus forms by the cells remaining together after fission had occurred. Simpler forms unbranched, *e. g.*, conferva; or branched, *e. g.*, cladophora. These also produce at times volvox-like ciliated cells.

Evolution of sex. In the simplest forms the whole unicellular individual is at once vegetative and reproductive. At first reproduction effected by simple fission, purely non-sexual. In simplest form of sexual reproduction two individuals fuse into one. Next there is a difference in the size of the two individuals; the larger, the female; the smaller, the male. A step higher, the female cell loses the power of motion, and remains passive in a special cell (öogonium), where it is fertilized by the active male cell.

Algæ and fungi. Fungi a specialized group of obscure origin; throw no light on the origin of the higher plants.

Algæ—green, red, brown. The former a generalized group from which the others have probably sprung; the others highly specialized, mostly marine forms. The green algæ mostly fresh water forms, and important as the progenitors of the higher land plants.

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LECTURE XXXIX.

Evolution of the Higher Plants.

Prof. Douglas H. Campbell.

Bryophytes (mosses and liverworts). Have probably been derived from the higher green algæ.

Mosses a sharply limited specialized group in contrast to the generalized class of the liverworts. The latter show affinities on one hand to the algæ, and on the other to the ferns; as well as having evident relationship to the mosses.

Bryophytes show a well-marked alternation of a sexual phase (gametophyte), and non-sexual stage (sporophyte).

In lower forms the sporophyte is insignificant, and entirely devoted to spore formation; in the highest (anthoceros) the formation of spores is less important, and the sporophyte has a well developed assimilative system of tissues.

Anthoceros leads directly to the pteridophytes (fern-like plants) in which the sporophyte develops roots and becomes an independent plant. Ophioglossum among living seem to come nearest to anthoceros.

In pteridophytes the germinating spore gives rise to gametophyte (prothallium), which becomes more and more reduced from the long-lived liverwort-like gametophyte of the lower homosporous ferns to the rudimentary gametophyte of the heterosporous forms. In

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heterosporous pteridophytes the gametophyte is diœcious, and this is indicated by the two kinds of spores — large ones (macrospores) that produce female plants, and small ones (microspores) that produce males.

Pteridophytes the highest plants in which the male cells (spermatozoids) retain their primitive motile condition, and recall the aquatic origin of the archegoniates.

Sporophylls of the pteridophytes the first rudiments of flowers. The "cone" of a lycopodium or equisetum the homologue of the flower of a pine. Both consist of groups of special sporophylls. Microspore : pollen grain ; macrospore : embryo sac. Pollen-sac and ovule are morphologically sporangia. The seed is a specially developed sporangium.

In spermaphytes fertilization effected by the nucleus of the pollen spore carried to the embryo-sac by the pollen tube.

Gymnosperms and angiosperms. Naked-seeded and covered-seeded plants.

Flowers of angiosperms usually have necessary leaves (petals, sepals) specialized for protection and attraction. The latter closely correlated with visits of insects.

Modifications of flowers and insects intimately associated. Both mutually dependent to a great degree.

Showy and edible fruits distributed by animals.

Color, odor, nectar of flowers, lures to insects.

Mechanical aids to cross-pollination. Diœcism ; proterandry ; proterogyny.

Special devices. Dead nettle ; sage ; orchids. Humming birds and flowers.

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LECTURE XL.

Spontaneous Generation.

Assumed by early writers. Omne vivum ex ovo. Omne vivum ex vivo. Discovery of infusoria. Ehrenberg. Assumption of their spontaneous generation, bridging the gape between living and non-living.

Work of Bastian on breeding infusoria in the interest of materialistic philosophy.

Work of Tyndall on cleaning tubes for optical experiments.

Work of Lister in antiseptic surgery.

Work of Pasteur on diseases of vines.

Work of Pasteur and others on fermentation.

Work of Jenner on smallpox.

Work of Koch on tuberculosis.

Experiments of Tyndall on floating matter in the air shows that germs of infusoria and bacteria are everywhere present, and that all these men were dealing with the same phenomena, the unsuspected germs of unicellular animals and plants, not easily destroyed. Germ theory of disease. Fermentation as "life without air."

No evidence that spontaneous generation now occurs. No possibility of recognizing it, should it do so.

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LECTURE XLI.

Man's Place in Nature.

Title from Huxley. Essential fact of biology that man's place is in Nature. Part and parcel of Nature.

If homology indicates blood relationship, nowhere are homologies more clear than between men and monkeys.

Man differs from average Old World monkey structurally, less than these differ from each other. An outside intellect would not doubt his blood relationship with them. Our doubts arise from the fact that man is an interested party.

Group of primates.

Attempts to separate man as a group from other primates. Structural distinctions slight. Tail. Hair. Form of great toe. Length of arm. Attitude in walking. Size of lower jaw. Size of brain.

Mental distinctions very great: speech; memory; abstract thought; use of tools; ability to make records; to look before and after; ethical sense; recognition of property rights; perfection of coöperation. Evolution of power of choice; how and why this has arisen. All these relative; increasing with increasing civilization; possessed in slight degree by apes; in not much greater degree by primitive man.

Primary division among primates into *Lemurs*, the original stock; *Old World* monkeys with narrow noses;

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New World monkeys with broad noses. Man's place with the Old World forms.

Darwin's work led to conclusion: If animal and plant species arise through natural laws, if homology is the stamp of heredity, then man must have arisen through natural law. The homology of man with apes indicates common heredity. Hence man must have come from some Simian stock, some forms likewise ancestors of apes. Ancestoral man arboreal, hairy, with long arms and pointed ears; probably also nomadic.

1. Theory of wholly independent origin of man. No standing in science. "Resolved, That man was created by an instantaneous process without previous animal parentage."

2. Assumption of descent of man from anthropoid apes, because these seem nearest man.

3. Argument from teeth that man a separate offshoot from lemurs.

4. Theory of Saltatory Evolution of man (analogy to Ancon sheep). Absence of facts for or against.

5. Theory of extra-natural origin of human mind (Wallace). Objections: Unnecessary reference to unknown causes. Not line of least logical resistance. Lack of recognition of epoch-making forces. Analogies from human history.

6. Man a nomadic ape. His powers the result of his cosmopolitan qualities. Narrowing effect of life in tree-tops.

7. Man an ape of prolonged infancy.

Primitive man a creature of large energy and large possibilities. Value of latent power as against used-up possibilities.

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Difficulties in the study of the origin of man.

Barbarous man writes no history. Leaves no record but tools of stone or bone. Iron rusts; bones decay; wood decays. Fossils only formed by burying of hard-parts from air, in quicksands, caves, and coral reefs.

Men and monkeys have almost no fossil remains.

Less primitive man destroys all remains of more primitive man. Love for antiquity a modern matter.

Oldest men recorded in history scarcely nearer the beginning of *man* than we are now. The idea of history implies civilization.

Study of origin of man conducted at great disadvantage; hence not pursued as more fruitful studies are. Embryology has yielded more light than archæology; indirect than direct methods.

Search for missing links. What is a missing link? say between horse and cow? Not a horse-cow, but a generalized animal, like an embryo horse or cow in structure, and capable of developing into either by specialized influences. So missing link not a man-ape, or ape-man, but a generalized creature, in internal structure like a new-born child. The primitive race, child-like race. The apes dwarfed old men who have developed in another and narrower fashion.

Earliest human remains; some ape-like, but not more so than Australians and some negroes. Blue-gum negroes, blue-gum apes. Old-time folks.

Speech of apes. Their intelligence, mischief, and cruelty; their tenderness and unconventionality. The story of Bimi (Kipling).

Growth of human qualities: (1) Migration; (2) use of tools; (3) speech; (4) record; (5) property rights;

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(6) memory; (7) abstract thought; (8) interest in future conditions; long-headed selfishness; (9) ability to discard present for future pleasures; (10) ethics.

Non-automatic powers involved in the power of choice. Self-consciousness and intellectual processes generally a result of natural selection in complex environment. Primitive man must think or die; automatic nerve connections insufficient. Once started on intellectual growth; this most valued result of natural selection. Its efficiency increased by mutual aid. Growth of civilization.

1. Man has assumed an anthropocentric universe, built by an anthropomorphic force. For we know no other names for the infinite intellect and will than those drawn from human experience.

2. Man has assumed a separate origin for himself.

3. That all things on earth must justify their existence by helping him; what he cannot use he will destroy.

4. That forces of Nature do and should make an exception in his case. Spirit of evil in them when they do not.

One good result of civilization that it enables "to endure the agonies of suspended judgment."

"A sacred kinship I would not forego
Binds me to all that breathes;
I am the child of earth and air and sea.
My lullaby by hoarse silurian storms
Was chanted. Through endless changing forms
Of plant and bird and beast unceasingly
The toiling ages wrought to fashion me.

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"Lo! these large ancestors have left a trace
Of their strong souls in mine;
I grow and blossom as the tree
And ever feel deep-delving earthy roots
Binding me closer to the common clay.
Yet with its airy impulse upward shoots
My soul into the realms of light and day."

— *Hjalmar Hjorth Boyesen.*

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LECTURE XLII.

Evolution in Social Institutions.—Principles.

Prof. George E. Howard.

I. The Nature and Scope of Social Institutions.

1. What is comprehended by the term institutions. (*A*) Society as a *whole* is an organism. (*B*) Society is a *complex* of many individual organisms.

2. Institutions are the solid framework of history. They are the residuum or resultant of social integration and disintegration — of social struggle.

3. Institutions are living organisms. (*A*) They are the outward expression of the thoughts and habits of men. (*B*) They bear a striking resemblance to animal organisms. (*a*) An institution exists in the *concrete* and in the *abstract*. (*b*) Analogy between society regarded as a complex of individual organisms, and an animal structure regarded as composed of living, separately organized cells (See Hæckel, "Evolution of Man," Vol. I.; Janes, in *Popular Science Monthly*, June, 1892). (*C*) May we regard society as having a *sensorium?* (See Spencer's "Justice": Part IV., "Data of Ethics").

II. Institutional History is a Biological (Natural) Science.

1. Significance of the present use of the terms "inductive," "comparative," and "historical": history has become biological, while natural science has be-

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come historical. (*Cf.* Fiske, in *Popular Science Monthly*, September, 1891).

2. Origin of the doctrine of Evolution as applied to institutions. (*A*) Influence of Aristotle ("Politics," I., 2: Jowett, I., p. 2 ff.); Plato ("Laws," III., 680 ff.: Jowett, II., p. 209). (*B*) Influence of George L. v. Maurer, Freeman, and others.

3. Institutional history has a scientific *method*. (*A*) The historical laboratory. (*B*) The establishment of the first historical laboratory (Seminarium, Exercitationes Historicæ) by Leopold von Ranke, in Berlin, Ca., 1830. (*C*) History has an efficient scientific nomenclature, whose terms are historically significant. Examples.

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LECTURE XLIII.

Evolution of Social Institutions. — Applications and Illustrations.

Prof. George E. Howard.

I. Illustration of the Biological Basis of Historical Evolution.

1. Institutional history is largely the history of conduct.

2. Conduct is an evolution. (*a*) Natural selection and crime (Morse, in *Popular Science Monthly*, August, 1892). (*b*) Natural selection and moral regeneration.

3. Bearing of the doctrines on the future of society and the law.

II. Institutional Evolution Presents the Phenomena of Organic Evolution.

1. Decay and revival of organs and functions.

2. Continuity and differentiation in variety and species.

3. Survival or fossilization.

III. Examples of Survivals.

1. Hearth or ancestor-worship.

2. Marriage by capture.

3. Marriage by purchase.

4. The blood-feud and self-help. (*a*) English *peine forte et dur* and *distress;* the Roman *pignoris capio;* and the Hindoo "Fasting at the Door." (*b*) Primi-

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tive measure of punishment for crime; symbols of violence in judicial process, etc.

IV. Examples of Continuity, Differentiation, and Decay.

1. The English lord lieutenant and the petty constable.

2. Six ages in the history of the township.

3. Differentiation of the English courts and councils from the Curia Regis.

V. Biological and Institutional Problems Compared.

1. The difficulty, often, in reaching satisfactory conclusions on the most important questions.

2. Compare: (*a*) The theory of the Patriarchal family vs. that of the Horde, as the embryo of social organism; with (*b*) the theories of Lamarck and Darwin vs. that of Weismann, as to the transmission of acquired traits.

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LECTURE XLIV.

History of Evolution.

As a philosophical suggestion, very old. Shrewd guesses and unverified suggestions comparatively valueless. Lucretius.

Linnæus, "Systema Naturæ," 1758; a system of scientific nomenclature enabling the keeping of perfect records. "As many species now as there were different forms created in the Beginning by the Supreme Being."

Lamarck, "Philosophie Zoologique," 1800. Development of species through functional use and disuse, and the slow willing of animals.

St. Hilaire, 1815. Gœthe: "sanest of men."

Cuvier. "Règne Animal," 1817. Origin of species an insoluble problem. As many species now as had come into being with the present zoological era. Lamarck overborne by the weight of authority of the father of studies in homology.

Robert Chambers: the "Vestiges of Creation."

Agassiz: "Essay on Classification"; species the thoughts of God.

Darwin: "Origin of Species," 1859.

Origin of species: the mystery of mysteries. Life problem of Darwin. Devoted himself for twenty-five years to collection of all facts which bear upon it. Assumption, that as the appearance of species is a fact

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of Nature, it must be brought about by natural laws. Science must assume that the origin of man or the growth of the state are as much natural processes as the sprouting of corn or the formation of a snow-bank.

All natural phenomena produced by natural laws, unvarying and unchanging. Can be no respecters of persons. Science can recognize none other than its own methods. Cannot recognize intuition as a source of objective truth. Luther's remark. Nor can it recognize logic alone. Helmholtz's remark. Nor can it recognize authority.

Relation of Darwin to Lyell's work. All changes in the earth's crust produced by the slow action of existing causes. Valleys not made by the hammer of Thor, but by the slow action of water, or the grinding force of ice, and the destruction due to frost. Ice, frost, and falling water stronger giants than Thor, as the Norse mythology tells us. See Carlyle's "Hero Worship."

Darwinism. Uniformitarianism applied to geology. The strong gods in the changes in life are the factors in Organic Evolution. Of these Darwin brought to light the hidden force of Natural Selection. *Heredity; Individuality; Force of Environment; Natural Selection; Self-Activity; Mutual Help; Segregation in Isolation.* These, some of the forces; all sometimes spoken of as gods, or fates, or giants. Because human growth, as all other growth, is hemmed in by them, and shows itself in reaction from them.

Place in science of the Origin of Species.

Alfred Russell Wallace, "On the Tendency of Varieties to Depart Indefinitely from the Original Type."

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Relation of Darwin's work to Lyell, Huxley, Hooker, and Gray. The younger and more observant naturalists would find in this work confirmation of their own observations.

Thomas Malthus (1795, "Principles of Population"), and Charles Lyell ("Principles of Geology"); true precursors of Darwin.

Darwin's other works, "Descent of Man," etc.

Darwin's life and methods of study.

Visit to Down. "He lies in Westminster Abbey by the side of Isaac Newton, one of the many noble men who made his own life possible. Among all who have written or spoken since his death, by none has unkind word been said. He was a gentle, patient, reverent spirit, and by his life has not only science, but our conception of Christianity, been advanced and ennobled."

"I believe that I have acted rightly in steadily following and devoting my life to science. I feel no remorse from having committed any great sin, but I have often and often regretted that I have not done more direct good to my fellow creatures."— *Darwin.*

"It comes out very clearly that Darwin did not rejoice over the success of his own theory of Evolution, that modification is due mainly to natural selection. On the contrary, he felt strongly that the really important point was that the doctrine of descent should be accepted."— *Francis Darwin.*

The storm provoked by the "Origin of Species." "Extinguished theologians about the cradle of every infant science, like the strangled snakes beside that of the infant Hercules."

Agassiz said: Three stages in the attitude of con-

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servatism toward any new truth: (1) It contradicts the Bible; (2) nothing new in it; (3) we have always believed it.

John Wesley, "Survey of the Wisdom of God," 1775: "In process of time many important discoveries have been made, which have been gradually assented to as prejudice could give place; allowing that it takes a century to make a discovery, it requires another century to remove a prejudice. The modest efforts of reason are too feeble to shake the foundation of error.

"The same general design comprises all parts of the terrestrial creation. . . . Various productions of the earth are not different strokes of the same design . . . only so many various points of a single stroke.

"All is metamorphosis. Forms are continually changing. The quantity of matter alone is unvariable. The same substance passes successively into the three kingdoms. The same composition becomes by turn a mineral, plant, insect, reptile, fish, bird, quadruped, man. . . . The gradation that subsists between all the productions of Nature. 'Links that unite.' . . . *The ape is this rough draft of man.* This rude sketch an imperfect representation, which, nevertheless, bears a resemblance to him, and is the last creature that serves to display the admirable progression of the works of God. Mankind have their gradations as well as the other productions of our globe. There are a prodigious number of continued links between the most perfect man and the ape."—*John Wesley.*

"The progress of science must be slow; see what a turmoil a little advance can make."—*Benjamin Franklin.*

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LECTURE XLV.

After Darwin.

Huxley: "Extinguished theologians lie about the cradle of every infant science as the strangled snakes beside that of the infant Hercules." "There can be no alleviation of the sufferings of mankind except veracity of thought and action, and the resolute facing of the world as it is."

Gray. Hooker. Lyell. Herbert Spencer and the "Philosophy of Evolution." Hæckel, John Fiske, Bagehot, Romanes, Lloyd Morgan — expositors of Evolution. Francis Galton and ".Inheritance." Ray Lankester and "Degradation." Boveri, Maupas, Hertwig, Brooks, Wilson — workers in Embryology. August Weismann, "Theory of Heredity." Cope, Hyatt, Osborne — defenders of Neo-Lamarckism in America. Lester F. Ward, "Pyschic Factors in Evolution." Le Conte, Drummond, Fiske, Schurman — reconcilers of Religion with Science. Huxley, Hæckel, etc.— the unreconciled. Andrew D. White, "Warfare of Science." "Religion and science must each run its own course, and I am not responsible if the meeting point be far away."—*Darwin.*

A conflict of the immortals; Religion always defeated in the struggle; always arises strengthened after each defeat. No need of premature reconciliation.

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LECTURE XLVI.

Spencer's Formula of Evolution.

Prof. William H. Hudson.

Scientific treatment and philosophic treatment of Evolution to be kept distinct. The Synthetic Philosophy as the philosophy of Evolution. Meaning of this statement.

Evolution, what is it? Vague and shifting significance of the word in current use. Metaphysical implications. Evolution and Progress. What do we mean by "high" and "low" in organization?

Starting point of Spencer's study of Evolution on its philosophical side. Line of approach, and its consequences. "Social Statics" (1850), and the doctrine of individuation.

German speculation on the development of the individual organism. Von Baer's law: development of organism a change from homogeneity to heterogeneity of structure and function ("Entwickelungsgeschichte," 1829). Spencer expands this into the law of all progress ("Progress, Its Law and Cause," 1857; "First Principles," first ed., 1862).

Does this sum up the whole matter? No. There are changes from relative homogeneity to relative heterogeneity which are obviously not changes in the line of Evolution. All Evolution implies increase of complexity, but all increase of complexity is not Evo-

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lution. What is the difference? Where shall we find a law to condition this of increasing differentiation?

Spencer's return to the doctrine of individuation, expounded in "Social Statics." Individuation must involve unification. Reinstatement of the doctrine of unification in Spencer's thought. Evolution: increase of heterogeneity along with increase in unification. Change towards complexity is change in the line of Evolution only where increase of complexity does not break up or jeopardize the organic unity of the aggregate. In Evolution increasing specialization of parts must be accompanied by increasing mutual dependence of parts in a coherent whole.

Full formula thus reached: Evolution is a change from an indefinite, incoherent homogeneity, to a definite, coherent heterogeneity, through successive differentiations and integrations.

Criticism of this formula. Applications of it to the phenomena of biology, psychology, sociology, and ethics.

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LECTURE XLVII.

Present Battle-Grounds of Evolution.

Discussion of Disputed Questions in Evolution from the Standpoint of Science.

Science is knowledge set in order. Disputed questions are those (1) in which facts are not sufficient for a decision, and (2) in which search for such facts may hope to be rewarded. Science does not concern itself with insoluble problems, nor does it dispute over solved problems. The best men in science work in fruitful fields. A theory in science may be valuable as indicating a direction for work, giving opportunity for decisive tests. Scientific use of the imagination. A theory, no matter how plausible, is valueless for any other purpose. Science cares nothing for guesses, even though marvelously shrewd. The logic of science is a deduction from facts. It is impersonal, unemotional, and might be made by an automatic logic machine. "Nature abhors a generalization." Science can recognize only those generalizations which are so supported by facts that the conclusions are evident to all who know the facts. A hypothesis valueless if nothing can be said against it; that is, if incapable of verification. Hence science differs from speculative philosophy. Helmholtz says that the latter deals with such "schlechtes Stoff" that its conclusions have no value. Hence such discussions as monism versus

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dualism not a part of science. Are mind and matter one? and if so, which one? What is the origin and character of the soul? These questions belong to Philosophy.

Evolutionists have been often divided into theistic, agnostic, and atheistic. No pertinence in such a division as applied to Evolution. Evolution deals not with opinions but with questions of scientific truth. Its propositions true or false, whatever the observer's philosophical or religious belief. As well speak of a theistic multiplication table, agnostic electricity, or atheistic chemical affinity, as to apply these terms to Evolution. Science has nothing to do with pre-determined conclusions.

Ground disputed between religion and science; one or the other trespassing. Religion gains every time it is driven off from scientific ground. "Plus on lui ôte: plus il est grand."

Some Unsettled Questions Not Discussed by Science:

I. Origin of life. Where, when, how? No data attainable.

II. Spontaneous generation. No affirmative evidence. Only theoretical negative evidence. No means of recognizing life fresh from the mint of creation, even if existing.

Questions Discussed, but Without Hope of More Perfect Answer:

I. Significance of pain.

II. Warrant of ethics. Is happiness, or growth, or better adaptation, the end of right-doing?

III. Indifference of Nature.

IV. Destiny of man.

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Questions Subject to Investigation, With Hope of Results:

I. The inheritance of acquired characters. (The most important present field of discussion.)

1. McFarland's illustration of the owl and the egg: (*a*) Was the owl first, the egg a concentration of its qualities in a specialized cell to reproduce the owl? — *Spencer, Lamarck.* (*b*) Was the egg first, the owl a bi-product of its development, and the new egg a continuation of the old one, modified by amphimixis, but not affected by the efforts and experience of the owl? — *Weismann.* (*c*) Are the owl's acquisitions — those gains and losses in his hereditary equipment which are results of his activity or idleness — transmitted as distinctive influences to the owlets? (*d*) Does heredity repeat only the original material carried in the original egg nucleus?

2. Are the ghosts of Ibsen real?

3. Are the laws of heredity indifferent as to whether qualities are latent or developed?

4. Is instinct inherited habit?

5. Is instinct a selection of desirable tendencies among possible ones?

6. Is civilization the inheritance of past success?

7. Is civilization the "sum of those contrivances which enable man to advance independent of heredity"?

"Considering the width and depth of the effects which the acceptance of one or another of these hypotheses must have on our views of life, the question, Which of them is true? demands, beyond all other questions whatever, the attention of scientific men."— *Herbert Spencer.*

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II. Sexual selection. Does the male grow strong and brilliant of plumage because the female prefers strength, brightness, activity, and song? Or are these qualities simply co-ordinated with the strength which enables the favored male to overcome those less favored?

III. Origin of the fittest. Law of acceleration and retardation. Effect of amphimixis. Unsolved problems.

IV. Origin of man.

1. Descent from anthropoid apes (form).
2. Descent from Lemurs (teeth).
3. Saltatory evolution.
4. Extra-natural origin of human mind.— *Wallace.*
5. Man a nomadic ape.
6. Knowledge of good and evil.
7. Speech.
8. Infancy.
9. Tools and fire.
10. Tribal relations.

V. Origin of ethics. Inheritance of experience, or natural selection, or education. Tribal ethics expanded to general ethics.

VI. Origin of the various groups of animals and plants. An immense field of research, involving all forms of biological knowledge.

VII. Application of laws of Evolution to man.

1. Can we assist Evolution?

"When Nature falters, fain would Zeal
Grasp the felloes of her wheel,
And grasping, give the orb another whirl."

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2. Can we improve mankind by improving his hereditary qualities?

3. Can we help mankind by improving environment?

4. Can we help mankind by substitution of coöperation for competition? If so, how? By government? By social changes? By individual effort? How keep from destroying self-activity?

5. Are "all philanthropic undertakings mischievous meddling with the course of Nature"? "The final result of saving people from their folly would be to fill the earth with fools."— *Spencer*. "He who falls in the press has only to lie there and be trampled broad."— *Carlyle*. Hence men must be better before they can be happier.

6. Why not then be brutal? Why not destroy inefficiency? Because *brutality* leads to barbarism and away from civilization. Practical results of it.

7. Why not let Nature go on; let the diseased, weak, and profligate exterminate themselves? Because "gangrene is not a desirable caustic. Social cancers infect more than they eat away."— *Warner*.

New investigations bring new questions. The unsolved questions will never be wanting, but they will center around those investigations which are fruitful in results.

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LECTURE XLVIII.

The Philosophy of Despair.

Prof. Edward A. Ross.

Heredity.—The fable of a free will. Is each the arbiter of his own destiny? Job. Nature's supposed deference to human desert. The facts of heredity. Whether by what our fathers *were*, or by what they *did*, we still are *made;* fathers' weaknesses nearly as bad as fathers' sins. "Allah has bound every man's fate about his neck." Punishing to the third and fourth generations. Nature's justice versus poetic justice. The illusion of free will. The initial thrust into life; we awake on a slippery incline, and can veer but little to the right or left. The new fatalism.

Progress.—Past development no security for the future. As a beggar who awakes to find himself on a throne surrounded by prostrate courtiers knows not what moment he will become their sport, so we know not when we shall find the current of Evolution against us. Adaptation proves no kindly design. The cake fits its pan because it was once dough. The glacier and its bed.

Conduct.—The dark past of the race; struggle and sorrow, blood and tears. The Golgotha of Humanity traced in history. The struggle for existence and its awards. The fittest not always the righteous. How the ape and tiger traits live on. The conflict between

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the inherited nature and the acquired ideal. The burden of Adam's sin. The new Calvinism.

Knowledge.— Our impotence to know. The mathematical and speculative faculties mere by-products; no guarantee of their competence to reach the heart of reality. We assist the senses with instruments, but wherewith shall we assist the reason, when it falls short? Faculties suited to rude practical uses have no warrant of success in probing the nature of things. Can we etch with a crowbar, or shear silk with a ploughshare? The islet on the dark sea. The new scepticism.

Happiness.— The origin of desire. Function versus feeling. Nature's bribery. Is the satisfaction of desire the path to happiness? Schopenhauer's argument. Man the sport of Nature. Goaded and stung by desires across the stage of life. Ennui. Thirst and surfeit. No net gain along the main track. Our throats but choked with dust. The ascetic remedy. The quenching of desire. Release from wishing. Apatheia. Nirvana. The new asceticism.

Decay.— Why not a leap from the summit? Browning's "Cleon." Knowledge grows while the power to enjoy declines. Building a tower that settles under our feet. The impermanence of acquisitions. The crumbling of personality into dotage and second childhood. The fire dies to smouldering coals. The bright river loses itself in sand.

Death.— Why Azrael, the black angel, is stationed at the exit of life. The warder selected by the struggle for existence. The fear of death and the will to live.

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LECTURE XLIX.

The Way Out of Pessimism.

Prof. Edward A. Ross.

Heredity.—Limited transmissibility of taints and defects; all our ancestors of the surviving fittest. Most weaklings in the ancestral stock weeded out ere we were born. Our parents must have reached maturity, at least. New aids in the combat with inherited evil —diet, climate, hygiene, literature, personal influence. How heredity cherishes cheerfulness. Not the children of the despairing shall inherit the earth. The world belongs to its enjoyers. Life thrives not by despair but by hope.

Progress.—How supported and upborne by the cosmic process. No serious change to be feared; the environment reliably stable; city life the chief new element. The rhythm of progress not discouraging.

Conduct.—The elimination of the cruel and treacherous under the regime of order. Since the dawn of civilization a survival of the comparatively just and righteous. Certain horrors forever done with—cannibalism, human sacrifices, blood-thirst. Self-extinction of the vicious and sensual. The crust over the savage thickens and will stand more strain. Fewer explosions of the seething primitive passions. The problem of sin not what it once was. Good men no longer

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seek the desert or the monastery. Righteousness getting wrought into the social order.

Knowledge. — Evolution positive as well as agnostic. Much to be hoped from the *élite* intellects of the race. Is it having or pursuing that delights? Lessing's parable. The joy of intellectual activity. Ecstacy in pure mathematics — the great moments of discovery. The reward not in the acquisitions but in the acquiring.

Happiness. — Schopenhauer w r o n g ; happiness takes time. Elation that lasts for hours. Not all pleasure preceded by the pain of desire: some pleasures psychologically cheap. Health, physical vigor, buoyancy and elasticity, waking from sleep. Relation of hunger to appetite. Non-organic pleasures that can not be recollected — music, scenery. Impressionism. Costless joys. Desire may be brief and satisfaction long. The physiological basis of enjoyment; renewal of power to enjoy; revival of interest. Law of variety; need of versatility. Law of moderation. The Greek ideal of temperance. Pleasures of scenery, art, friendship, and social intercourse.

Ennui cured not by fresh desire but by activity. The natural overflow of energy. Ascetism unscientific. The new basis for humanism. Resignation and passivity violate the fundamental laws of happiness. Where lies the zest of life for men of action? Mountain-climbing, sight-seeing, exploring, pioneering, fighting, reforming. Stanley, Phillips, Roosevelt. Creative joy. Pleasure hunting versus immersion in congenial work. The end held cheap. Working for others. The strong helping the weak. Health, work,

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rest, recreation, variety, are the positive requisites of a happy life.

Decay.— Old age in savagery and in civilization. The beautifying and beatifying of age by filial love. Not all decays — character lives when acquisitions have fled. De Quincy.

Death.— The rounding off of life. The ripened apple ceases to cling to the stem. The aged unreluctant to die. "Life a dream." Decline of vitality. Life's fever cools. Shrinking from death ceases as the surge of life energy dies away. Serene waiting. Euthanasia.

Summing Up.— Life not so much task as play. "Go to work" really means "Go to play." Reaping joy as we go along. Overearnestness to be discouraged. Life not to be taken too tragically. Reserve a portion of thyself.

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LECTURE L.

Philosophy and Science.

Philosophy:

Philosophy intuitional; speculative.

Philosophy of science the "evanescent perspective in which the facts of Nature appear to man."

All science involves more or less of philosophy. Reality of external things; bridging of gaps necessary in all induction. Not a complete series of facts ever available.

All philosophy necessarily in part false. All philosophy ultimately becomes wholly false; as the truth becomes verified and becomes common ground, the unverified remnant becomes error. The philosophy of the past opposed to science. The philosophy of science opposed to the philosophy of the past; but it ultimately becomes opposed to science as well. Materialistic philosophy arises from science, but becomes ultimately opposed to science. "Star-dust," "Atom-Seele," "molecular-mind," and the like as mythical as spooks and demons.

The conflict between science and old philosophies not allayed by any new efforts of speculation. Only by passing on to new grounds of truth. Lessing's remark.

Noblest pleasure of human mind in drawing generalizations from unwilling Nature, because this demands highest effort.

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"When we are asked why we study that which we call Nature we stammer and are silent. We feel as the Creator might feel if asked why he had made all these things."— *Persian poet.*

Non-Resistance of Science:

"Old errors do not die because they are refuted. They fade out because they are neglected."— *Holmes.*

Good work constructive. Huxley's parable of the fence. How Darwin, Lyell, Gray, Hooker, treated the fence. How Huxley and Hæckel treated it.

Huxley devoted his life to teaching the people and to breaking down "Ecclesiasticism." His part in the "warfare of science." Has this brave struggle for scientific freedom made science more free? Was it undertaken for this purpose, or to gratify a love of fight? Was the happiness of the fighter in the results, or in the effort? Does science win, or does Huxley, with his splendid literary style and trenchant pen?

Futility of controversy. May be good fun, but ineffective in advancing truth. Controversy equalizes opponents. Holmes's remark. We form a ring about a fight and see that both sides have fair play. The question becomes, Which combatant is most skillful? — not, Which is right? In fair controversy neither is right.

Truth recognizes neither fair play nor courtesy, but smites error wherever seen, as hunters kill rattlesnakes. Does not even show the courtesy of a rattle. Rather destroys error, as sunshine destroys the frost or the mists of morning.

Logic of persecution. Its failure to recognize that

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no man possesses truth. Men may struggle toward it or drift away from it. Those who would limit the human mind always headed the wrong way.

It was written long ago, "Those who worship Jove — the highest God — may be content to despise the lesser gods in silence."

As for the devils, the very least of the gods is more potent than the strongest of them.

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LECTURE LI.

Religion and Science.

Prof. Wilbur W. Thoburn.

Are they antagonistic?

The so-called warfare not a clash of facts, but a battle between definitions. If the combatants could cease fighting long enough to understand each other they might end by agreement. The two-sided shield.

The active, working men rarely stop to quarrel. Neither side ever reaps any good by attacking the other.

"Science must be studied by its own means and to its own ends by men trained in its methods."— *White*, "Warfare," p. 146.

Increase Mather's mastodon bones and Huxley's theology.

Some definitions and limitations.

Science:

Limited only by knowledge. Includes theology.

Not unreliable because changeable.

Usefulness of theories.

Theology Defined:

Not religion any more than any other science is religion.

Mischief arising from confusion here.

Two kinds of theology as of every other science: (1) stagnant; (2) progressive.

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No conflict between dead things. Safety and rest only in constant growth.

Religion Defined:

Confusion of ethics and religion. Impossibility of conflict between science and religion. Place of the church.

Limitations of the intellect. Office and use of faith in the pursuit of knowledge.

The Confusion Concerning Evolution:

Not a science; not a force; not a religion: creates nothing, and is not, therefore, a substitute for God. Tells how the Creator worked and so brings us into His presence.

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LECTURE LII.

The Evolution of Religion.

Prof. Wilbur W. Thoburn.

Is Evolution an ally or a foe? Misunderstood Evolution regarded as a foe.

The position of the rational theist strengthened by Evolution. An intelligible plan in Nature proves kinship with the intelligence back of the plan.

Is the religious life an exception to the laws of Evolution? The ghosts of religion.

Opposing Views of Man:

1. Struggling to regain a state of former excellence now lost.

2. Struggling to reach perfection and excellence never known, and hence never lost, but always the goal and ideal of life.

Our idea of religion and of Christ determined by our view of man.

These two views not so widely divergent as at first appears.

I. Consideration of first view. The Bible evidences of past perfection. Religions of savages degraded. Prevalence of a belief in ancient excellence. Christianity a hiatus.

The growth of the tree must be measured not at the tips of the branches but on the stem.

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II. Consideration of second view. Evidences of animalism. Mankind always advancing. Degraded races have dropped out of the process. Christianity a product — a climax.

The Course of the Evolution of Religion.— Like all history its beginnings are lost.

Basis for conjecture.

1. Mankind has always been moving in the direction of its present progress.

2. The laws of human action have always been the same.

3. The object of existence is perfect conformity with the environment.

Man's first state his lowest. His back toward the animal.

Relation of man's knowledge to his religion.

I. Naturism, indistinct, chaotic.

Primitive man unconscious of his superiority over animals, of his own personality, of his spirituality. Fear made the first gods, and they were simply living beings.

1. Polydæmonistic religions.

2. Therianthropic polytheism.

3. Anthropomorphic polytheism.

Through all an increasing belief in the soul, an increase in the value of a man, and an increase in the ethical element of religion. Lessons from childhood.

II. Ethical religions.

1. National — development of *henotheism*. Confucianism, Brahminism, Judaism.

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LECTURE LIII.

Evolution and the Bible.

Prof. Wilbur W. Thoburn.

Reasons for this discussion. The unique place of the Bible in literature and life.

The question not whether the Bible is inspired, but whether it grew or was manufactured.

I. The Bible on its merits.

More powerful in competion than in isolation. The ghost element in religion and in the Bible. Wrongly used as a substitute for thought. Parasitism, sentimentalism; impulse and action.

More valuable as a teacher than as an authority. Skepticism not so dangerous as sham — as making believe to believe.

The apparent conflict between the Bible and Evolution a conflict of interpretations.

The Bible and Nature equally a revelation of God.

II. Revelation. The unveiling of the divine in human consciousness. Misconceptions concerning revelation. Progressive and incomplete. Relation to knowledge. Infallibility and inerrancy.

III. Evolution of the Bible. Tradition, legend, history. Its symbolism the stumbling block of theology and the foundation of religion.

Not facts but truths. Not a scientific treatise.

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The first chapters of Genesis.

The value of the Bible not in its inerrancy but in the fact that it is a continuous, progressive revelation of God in and through men.

Evolutionists have more faith in growth than in manufacture.

1. Literary methods of the Hebrews.

2. The growth of the books. The lives of the patriarchs in the light of Evolution.

3. Polytheism to monotheism.

Contrast with the Chaldean and Phœnician mythologies. Evolution of love.

It is the Christ in the Bible which makes it a living book. Life is its only interpreter.

Conclusion.

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LECTURE LIV.

The Fool-Killer and His Mission.

The fool-killer — a metaphorical term for self-inflicted injury, avoidable through greater knowledge or greater faith in knowledge.

When we enter life "the gate of gifts is closed."— *Emerson*. Endowed with diverse and often contradictory tendencies to be blended into individuality; an hereditary measure of force and tendencies toward certain activities.

Health the condition when functions and activities work normally. Pain or sickness, signal that something is wrong. Ringing in ears a sign of organs out of order, as ringing of bells a sign of warning in machinery. Neglected signals cease in time, but not injury they signify. Faith cures largely due to elation in which signals are unnoticed. "Conversion of active into dormant hysteria." Pains Nature has not had time to develop; phases of environment strange to Nature's man. Man's man in new, hence artificial, environment. Comparison of bodily health to inherited estate. Money grows by investment, strength by self-activity. Hoarding health makes long life, accident aside. Hoarding money makes wealth, accident aside. "Taking out of the meal bag and never putting in soon comes to the bottom."— *Franklin*. Every waste of health or wealth counts in final reckoning.

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Overdrafts in flush times versus overdrafts in hard times.

Not always wise to save either wealth, or strength, or money. Relative value of different aims. Some things better than long life to some people, sometimes. But not often so to average man; choice must be made with our own consent; not left to the fool-killer. "Ich hab's gewagt mit Sinnen, un trag' dessnoch kein Reu." — *Hutten.*

We may spend our lives and strength knowingly for others (and often others would be better served had we saved them). We may be victims of hereditary limitations. We may be victims of others, or of untoward conditions.

We all waste life, strength, money — ignorantly or uselessly — and so carelessly or deliberately give ourselves a lower place in the struggle for existence than otherwise entitled to.

"To be born without brains not in itself a crime, but in a competitive civilization must be punished by hard labor for life."

Natural selection takes no account of native nor of hereditary limitations. To be born without financial sense a plea allowed neither by Nature nor our creditors. Insanity and insolvency pleas not accepted in court of Nature.

Natural selection distinguished from fool-killing. The latter takes account of what we might have been; records and punishes failure: (1) by reduction in length of life; (2) in enjoyment in life; (3) in power of activity; (4) in usefulness of life; (5) in perfection of development.

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In physical matters. Touch of wrong-doing heavy on little children. Nature destroys children of fools. Illustrations. Touch apparently lighter in the flush times of youth, the strength of early manhood; grows heavier as our reserve fund fails, till finally the slightest draft will put out the light.

The fool-killer and the student. Sleep: Night study. The "bright moment that comes after midnight." Bryan's words. Eyesight: Reading on the cars or in poor light. Stimulants: Deceive the nervous system. Every trick deranges delicate organisms. Wine. Tobacco. Coffee. Tea. Opium.

Beautiful fumes of burning nerves. Seeing stars. The great calm thinkers from Plato to Emerson did not write at midnight, nor over absinthe nor strychnine.

Every stimulus that hides fatigue comes from the fool-killer. The poetry of stimulants; the literature of pessimism. Tonics. Nerve foods. Strychnine. Sleep potions. "Bromides lead to Bromism, the loss of mental grip." Strength comes through action. Keep blood flowing. "Do not burn candle at both ends; not too much at either end." "Pleasures are like poppies spread."

Youthful folly. Sowing wild oats spoils ground for better crops. Fool-killer's record on every face. No gallantry in Nature. Woman, perhaps, should be untouched by the fool-killer; she is not. What woman's faces show. Penalties for tight-lacing, idleness, dissipation, foolish eating — all exacted.

Keep up your reserve and keep your functions active where they bring in good interest. Intellectual

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culture: Weak books weaken; never read to kill time —killed time avenged by the fool-killer. Strong books make you strong. Responsibility for clear thinking; must precede clear acting. Bad men never think themselves really bad. Moral culture: Keep up your reserves. Don't give the fool-killer a chance to taunt you with folly or crime; if you do he will keep at it all your life. If you would not come to shame do nothing you are ashamed of. Have nothing to conceal and half the worries of life are saved. It does not pay. Evil effects of self-pity and self-justifications. Evil effect of having done what one knows others would disapprove. Keep your temper. Keep your own counsel. Keep it so that no harm would come if all the world suddenly knew your inmost thoughts. Bad books, bad thoughts, bad deeds, leave bad marks. These pictures stay with you and are not pleasant to see in leisure of age. "Nature's infinite negative." Thoreau's remark — each man creates his own atmosphere, his own outlook. Surround yourself by pure air, looking out on clean things; blue sky, green grass, and lofty mountains. You can not afford to live, unless your own home is in Utopia. From that abode you can safely venture into Erebus even, if some one is helped thereby. But do not live in Erebus because the society is congenial. "When you feel inclined to become a rascal you have the qualifications for a phool."—*Josh Billings.* "The Shock." When a man's opinion of himself gives place to what others think of him. John's John and Thomas's John.

No one ever wholly escaped the fool-killer; no one

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ever deserved to escape. But let his touch be the warning touch of a friend, not the grasp of a police officer.

"Innocue vivito, numen adest."

"Cast away from you all your transgressions whereby you have transgressed; make you a new heart and a new spirit; for why will ye die, O house of Israel? For I have no pleasure in the death of him that dieth, saith the Lord God. Wherefore turn and live ye."—*Ezekiel.*

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LECTURE LV.

The Evolution of the Idea of God.

Prof. Edward H. Griggs.

Constant change in conceptions of the Divine.

This change relative to the development of human life.

The conception of the Divine never higher than the highest ideal present in any phase of life.

Hence the changing ideals of men are reflected in the changing thought concerning God.

Thus there is serious truth in the statement that "an honest god 's the noblest work of man."

Beginnings of the idea of God in the first recognition of power in Nature, and personality and power in man.

Development from these simple beginnings.

The relation of the Nature element to the human element.

Ways in which religion is determined by the conditions of life.

Nature religions grow up where man is dependent chiefly upon Nature.

Religions founded upon ancestor-worship, or the worship of the god of the tribe, grow up where man is dependent upon human strength.

The character of religion as determined by the proportion of these two elements.

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Contrast the development of Aryan Nature religions with the main Semitic ideas of God.

Change in the idea of God, as the tribe becomes a nation, and the nation cosmopolitan.

The idea of God as the All-Enfolding, All-Upholding Life, the natural outcome of Nature-religions.

The idea of God as Ruler and Father the natural outcome of religions founded upon the worship of the god of the tribe.

The comparative value of these ideas in the religious life.

The fact of constant change in the idea of God an evidence of partial truth in every phase of the belief.

The evolution of the idea of God considered as the progressive discovery by man of the *unity, harmony, and rationality* of the universe.

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LECTURE LVI.

The Evolution of the Family.

Prof. Edward A. Ross.

Tests of Family Types.—The biological test. The family exists for the maintenance of the species. The diverse and conflicting interests of species, parents, offspring. The best family must reconcile the welfare of the social group with that of children and parents.

The psychological test. The family exists for the promotion of happiness. Should have regard to the freedom of matrimonial choice, the often diverse and changing likes and dislikes of husband and wife, the desire of woman for independence and self-direction, the thirst of children for freedom and individuality, the helplessness of parents in old age, and the existence of parental and filial sentiments.

Primitive Sex-Relations.— Absence of love; woman seized by force, purchased, or taken from an enemy; no words or marks of tenderness. Absence of jealousy; presenting, exchanging, selling, lending of wives; unfaithfulness an infringement of property rights. No value placed on purity; laxity of the young. No horror at union of near relatives; intermarriage of brothers and sisters; incest no vice. General irregularity, indefiniteness, and impermanence of connections.

Early Family Institutions.— Promiscuity, polyandry, polygyny. Exogamy and endogamy. Kinship through

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the female line. The matriarchate. Competition of family institutions. Survival of the best family organization and of the best organized groups.

The Monogamic Family.— Superiorities. Definiteness of relationships. Multiplied family ties. Greater integration. Superior productiveness. Less mortality of offspring. Aids political stability. Reduces family dissension. Gives dignity to woman. Fosters marital love. Evokes filial affection.

Divorce.— Is marriage sacrament, contract, relation, or conduct? The rising tide of divorce. Its causes. Woman's chance to earn money; woman's growing habit of thinking; higher ideals of married life; rash marriages; the exaltation of the individual.

Evils: No home life for the children; encourages reckless marriages; cloaks adultery; removes motive to mutual adaptations.

Benefits: Arms outraged womanhood; breaks hateful ties; remedies matrimonial mistakes; confers freedom, and happiness through freedom.

The Patriarchal Family.— Primogeniture; descent in male line; agnation. Unlimited authority of the father. Subjection of women; of children. Joint property and responsibility of the family. Kinship and religion. Kinship and politics.

The Status of Woman.— Inequality of dress, education, occupation, amusements. Woman's sphere. The rights women want. Right not to marry, to earn her own living, to enter the professions, to get due wages, to be esteemed professionally, to fit herself by study, to have access to clinics, laboratories, lectures, libraries, to get recognition by diplomas. Right to marry, to control her person, to hold property, to simplify

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housekeeping, to have or not to have children. Right to paint, design, read, study, write, investigate, explore, sing, play, debate, lecture, preach, plead, travel, row, hunt, fish, climb, drive, etc.; in brief, *to enjoy life*.

Status of Children.— Young America. The rights of children. How affected by the rapid development of America. Limited by the child's lack of knowledge, its lack of power of self-support, and its lack of self-control.

Kinship.— Use and abuse of relatives; nepotism in politics and business. Familism defeats the ends of justice, condones wickedness, serves the upper classes at the expense of the lower, constitutes a tacit conspiracy against society. Familism and feudalism, aristocracy, social exclusiveness. Familism and conservatism. Effect of democracy on the family spirit.

Kinship a social filament. The family a mutual insurance company; promotes sense of solidarity; gives courage, hope, incentive; favors discipline and obedience; lightens the burdens of the state. Kinship as a basis for industrial association, social intercourse, charity, and beneficence.

The basis of family spirit. Old roof trees; historic homes; portrait galleries; libraries; mementoes, relics, heirlooms; visits; reunions. Familism and wealth.

The decline of family spirit. Few historic homes in America. No roof tree. Dispersion of members of the family. Migration. Rootlessness of American life. Small local attachment; love of "moving"; new nomadism. Drifting into different social strata, different occupations, different kinds of life. The American family and the American state.

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LECTURE LVII.

Saving Time.

"The gods for labor give us all good things."—*Epicharnus.* Fact of experience. Nothing of worth for other price. Temporary loans always charged heavy interest. "By their long memories the gods are known." The "gods" the personified forces of Nature. Human strength depends on our acting with them. He who knows the will of the gods can trust all and fear nothing. He who defies them wields a club of air.

Progress through self-activity. In saving of time. Law of acceleration. Degradation results from loss of time. Law of retardation. Drudgery of civilization; doing more than one's part because others do less.

Most of poverty due to unwillingness or inability to pay price of wealth. No one should take out of life what he does not put in. Each gets what he pays for. Gods give not all good things to same man. Each must choose. Who has earned right to choose is satisfied with choice. He who wastes time comes in for last choice. Leisure of life spent in advance; interest on borrowed time to pay to hardest of creditors. Degeneracy of gilded pauperism as of hopeless poverty associated with wasted time. Danger of future not in power of rich, but in weakness of poor. Weakness and waste carry misery to all joined to them in industrial

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alliance. Evil influence of desire to gain something for nothing.

Only the very strong can resist weakening power of unearned rewards. But one fortune to earnest man: that is opportunity. Opportunity comes to him who deserves it. Growing belief that day of hard work has past. That government should provide each man reserve force, won in the past by thrift and energy. Day of relaxation not arrived. "Time never comes when it will do to kick off duty life a worn-out shoe."

Burden of oppression. Burden of whisky, tobacco, dirt, and idleness. Farmers around patent-medicine venders. Swarms of idle men around every fool-killer's nests. Bird-lime of habitual idleness on their feet. They will never get away. Burden of taxes slight compared with burden of shiftlessness. Waste of machines to save time when time is wasted afterwards and machine left to rust. Waste of bad roads; waste of loitering. "Poor folks have poor ways."

Those who add nothing to economic value best supported in asylums at public cost. Why not a great state hospital for all men with valueless time? Appropriate salons for the idle "four hundred"; for the rest a great court-yard covered with sawdust, with dry-goods boxes where they may sit the whole year, talking politics to music of hand-organ, and watching trains go by. Rest of world could take world's work, with higher taxes, but with gain of open streets, clean houses, closed saloons, silent demagogues, pastures free from weeds and thistles.

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Land of Mañana. Everything put off till tomorrow. Time is short. Not much done if all is saved. Nothing if all is wasted. Grim humorist's remark, "We shall be a long time dead." He who is active earns the right to sleep. Earth "rolls away as a scroll," taking with it all limit, all environment. The "rest is silence."

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LECTURE LVIII.

The Evolution of the Common Man.

Government in interest of those governed.

To secure justice, security, individual development; to conduct enterprises of mutual advantage which serve people better than if conducted for private purposes.

Our history began in Europe. Rule of strength and superstition ending in rule of nobility and church. Law of primogeniture succeeding force; but not maintaining ability.

The schools arose from these. Higher first. Paris, Oxford. Higher education of noblemen and clergymen. Learning, manners, skill with sword, and music. The lute and the sword.

For the priest. Skill in debate. Philosophy. Classics. Spiritual exercises. The scholar a by-product; used in training gentlemen and priests.

"God said, I am tired of kings,
I suffer them no more;
Up to my ear the morning brings
The outrage of the poor.
Think ye I made this ball
A field of havoc and war
Where tyrants great and tyrants small
Might harry the weak and poor."

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America; the land of the common man, uncoddled by luxury, uncrushed by oppression, untainted by charity. Sons of "him that overcometh."

"The wisest men to make the public laws." America founded; made free by educated men. Their distrust of people, ignorant, uncouth, prejudiced; no virtue in multiplication of ignorance. Voice of people the voice of God. Voice of irresponsible ignorance. Voice of mob. Voice of mob that of demon. Mob conscious of power, not of responsibility. Elderkin Waldo.

Their distrust of aristocracy, immoral, inactive, prejudiced. Decay of luxury and idleness. Brains used and sifted. Red rags shaken. Samuel Adams.

Representative government on trial. No divine right in republicanism or in Americanism. Will fail if it deserves failure. Will get nothing it does not deserve. Must fail if it fails to secure wisdom. The wisest men do not make the public laws. Growth of civilization growth of its parasites. "Heir to all the ages I"; so are the enemies of good government.

Representative government; choice of those that *think* as I do. Those whose interests are mine; those attend to my interests. Representatives as attorneys.

Great problems to solve. Can republic meet them? Is it fit only for corn and cotton prosperity? Is our backbone wilting? Is the "Caucasian race played out"?

Weeping and wailing. Days of 1862.

Why are "all the common men so grand, and all the titled ones so mean"?

Moral questions. Heart of people beats responsive. All questions at last moral ones.

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A right and a wrong to every question. In long run must be settled right. Else comes up again and again. The highest wisdom is the only wisdom, not the wisdom that carries elections.

"They enslave their children's children who make compromise with sin," or with ignorance.

Slavery; how the question rose for settlement. John Brown. Lincoln.

Tariff. Finance. Paternalism.

There is a right settlement. There is no other. A representative government must be one of wisdom. Government is education. But government must furnish education. The children of the future must meet these questions. Else not met. Else our republic will go down as others have in "unreason, anarchy, and blood."

Hence duty of civic training. In real patriotism. To know is to back knowledge by action.

Duty of higher education. No longer clergyman or gentleman, but every man. Educate your rulers. Why we should "vex at the land's ridiculous misery."

Industrial problem confronts us. Hastened by artificial stimulus, waste, carelessness. Bad blood of immigration. Dead past not buried its dead. Flung on our shores.

Danger not in power and greed of rich, but weakness of poor. Coxeyism a painful exhibition of it.

Industrial problem solved only by better men and women. This generation cannot be helped. Save the children. Waste none of them. Purpose of kindergarten, industrial school, university, of all worthy schools. Not to make conditions easier; easy enough

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now, if they were just. To make men and women master of conditions. This by giving each one reserve force.

1. Thrift; a virtue; may not always be such, but will be for our day, and till Anglo-Saxon race is forgotten.
2. Skill.
3. Intelligence.
4. Character.
5. Reputation.
6. Love.
7. Family ties.

Men without reserve unwise and would be ground into dust even in Utopia. Unskilled laborer. Not do more than bucket of coal and bucket of water. Scarcely more effective than these.

A nation can be made up only of men and women who have something to lose by waste, lawlessness, oppression. Such as these cannot be oppressed.

Of all reforms, the real one is reform in schools. To meet every real need of people and to give every child a reserve force to hold place in the world. To every one without it a place should be given where his race can become extinct with least possible suffering.

"My will fulfilled shall be
In daylight or in dark.
My thunderbolt has eyes to see
Its way home to the mark."— *Emerson.*

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Books Recommended.

Agassiz: Essay on Classification.
Ammon: Die Naturliche Auslese Beim Menschen.
Bagehot: Physics and Politics.
Bergen: The Development Theory.
Brooks: Heredity. The Genus Salpa.
Chambers: Vestiges of Creation.
Cope: Origin of the Fittest.
Darwin: Origin of Species. Descent of Man. Expression of Emotions in Man and the Lower Animals. (Etc.)
Dugdale: The Jukes.
Ellis: The Criminal.
Fiske: Excursions of an Evolutionist. (And other collections of essays.)
Galton: Hereditary Genius.
Garner: The Speech of Monkeys.
Geddes and Thompson: Evolution of Sex.
Giddings: Scope and Method of Sociology.
Hæckel: History of Creation.
Huxley: Lay Sermons. (And other collections of essays and addresses.)
Ibsen: Gjengangere.
Jordan: Science Sketches. Essays in *Popular Science Monthly*.
Keeler: Evolution of Colors of Birds (Introduction).
Lamarck: Philosophic Zoologique.
Lankester: Degeneration.
Le Conte: Evolution and Christianity.
Lyell: Principles of Geology.
Malthus: Theory of Population.
McCulloch: Tribe of Ishmael.
Morgan: Animal Intelligence.

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Osborne: Contemporary Evolution of Man. Recent Problems in Heredity.
Powell: Our Heredity from God.
Ritchie: Darwinism and Politics. Pauperism in the Light of Natural Selection.
Romanes: Darwin and After Darwin.
Ross: Turning Towards Nirvana.
Schurman: Ethical Import of Darwinism.
Spencer: Factors in Organic Evolution. Data of Ethics. Synthetic Philosophy. Insufficiency of Natural Selection. (Etc.)
Stephen: Ethics of Evolution.
Tyndall: Floating Matter in the Air.
Wallace: Darwinism.
Ward: Practical Nature of Dynamic Sociology. Present Status of the Mind Problem. Psychic Factors in Evolution. Weismann's Concessions.
Warner: Evolution of Charities. Statistical Determination of Causes of Poverty.
Weismann: Essays on Heredity (two series). The Germ Plasm. All-Sufficiency of Natural Selection.
White: Warfare of Science.
Whitman: Biological Lectures (at Wood's Holl).

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